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THE NEW ENTOMOLOGICAL BUILDING AT THE MASSACHUSETTS AGRICULTURAL COLLEGE

The new entomological building recently completed at the Massachusetts Agricultural College is a large and commodious structure. It is placed on the eastern side of the campus, facing the west, and consists of two stories, basement and attic. It is constructed of brick and stone with a steel frame, cement floors and slate roof, and is considered to be entirely fireproof.

The building is in the form of an H, the cross bar being carried toward the front, thus giving a central building and north and south wings. The central portion in front is devoted to offices, supply rooms, and a library on the second floor. Behind, is an amphitheater rising from the basement and accommodating about 180 persons. Above this, on the second floor is the insect room, 20 by 40 feet, and a filing and stenographer's room. The north wing contains the zoölogical laboratory and a room for microtomy on the first floor, and the senior and graduate entomological laboratories on the second floor. In the south wing are the zoölogical museum, and three rooms for the entomological work of the Experiment Station, one of which is connected with the greenhouse for experimental work on insects. On the second floor of this wing are the gallery of the museum, an advanced lecture room, accommodating 60 persons, and a graduate laboratory for zoölogy. In the basement, besides the amphitheater, are rooms for determinative mineralogy and geology, for the rock collection, a pump and apparatus room, an insecticide analysis room, and toilet and fan rooms. In the attic are rooms for photography and developing, a storage room and the janitors' quarters.

The senior entomological laboratory is 28 by 72 feet and has tables for 75 students, and the graduate laboratory will accommodate twenty.

The building is lighted by electricity and heated by steam from the central heat and light plant of the college.

The building was constructed from an appropriation of $80,000 for its erection, and $15,000 for equipment, this sum also including equipment in zoölogy.

Though entomology, zoölogy and geology are at present located in the building, it is understood that when the growth of the subjects requires it, the last two will be transferred to other quarters, leaving this as the Entomological Building.

The equipment in entomology includes microscopes, microtomes, and all the other apparatus usually required for such work, and an unusually full supply of books, journals and literature.

The dedicatory exercises were held November 11, and consisted of an address by Dr. W. E. Hinds of the Alabama Polytechnic Institute on the history of the Departments of Entomology and Zoölogy at the college, and the Dedicatory Address by Dr. L. O. Howard of the U. S. Bureau of Entomology.

H. T. FERNALD.

[We understand that the excellent address by Doctor Hinds will shortly be published by the Massachusetts Agricultural College, while the admirable résumé of the development of entomological work in this country by Doctor Howard appeared in full in the issue of *Science* for December 2, 1910.—ED.]

SCUTELLISTA CYANEA MOTSCH.

By H. J. QUAYLE, *Southern California Laboratory, Whittier*

Scutellista cyanea Motsch. is the most important insect enemy of the Black Scale (*Saissetia oleæ* Bern.) in California. This insect was introduced into the state in 1900 by the U. S. Department of Agriculture through Dr. L. O. Howard of the Bureau of Entomology. It is now well distributed in all parts of the state where the black scale occurs in injurious numbers. The percentage of scales parasitized also runs very high, amounting in many cases to 75 or 80%. But this varies greatly in different sections and in the same section in different years.

In spite of the frequently high parasitization by Scutellista, the

black scale still remains the most important citrus insect pest in the state. Taking the citrus belt over, more control work is directed against the black than any of the other scale pests. And, with all this control work, according to a statement by G. Harold Powell of the Bureau of Plant Industry, in 1908, from 1/3 to 1/2 of the oranges of California were washed because of the sooty mold fungus resulting from black scale infestation.

While, therefore, this parasite is well distributed, and the percentage of scales attacked is often large, as parasitization goes, yet, from a commercial standpoint, at least, the Scutellista is not often a very important factor in the control of the scale. Of course, in many places the Scutellista may not be abundant enough to check the scales. But again where they are most numerous the scale continues to thrive. There is not, therefore, necessarily a direct relation between the abundance of the parasite and the scarcity of the scale. It is not unusual to find the greatest parasitization where the scales are most abundant; and, again, where the scales are scarce there may be very few Scutellista. This might be answered by the fact that the Scutellista being an egg parasite affects only the progeny, and that the scarcity of scales should be attributed to the abundance of the parasite during the previous year. This may sometimes be the case, but there are often other and less tangible factors at work.

Many have been accustomed to judge of the efficiency of the Scutellista on the basis of the number of scales with exit holes, but this is not the only criterion. Since the Scutellista is an egg parasite, the real test of its efficiency is in its ability to prevent young from appearing. It might seem that this is directly related to the number of exit holes in the parent scales, but this is not necessarily so. A black scale may lay from 300 to nearly 3,000 eggs, the average number being from 1,500 to 2,000. A Scutellista larva will mature on the minimum number of eggs, but, if they are available, it will of course consume many more. But the Scutellista larva often does not consume the maximum number of eggs, so that in large healthy scales there may be several hundred young that will appear in spite of the presence of Scutellista larva. It is because of this failure to consume all of the eggs, in the case of the larger scales, and the fact that from each one of the 10, 15 or 25% of the scales not parasitized, there may appear 2,000 or more young, that a tree may continue to be badly infested, notwithstanding the large number of scales with exit holes. This may explain why more than 700 young black scales were counted on a single orange leaf growing from a twig that had 75% of the parent scales parasitized by Scutellista. On the other hand, where the scales are small or of medium size, the Scutellista consumes all of the eggs,

and must be an important factor in reducing the numbers for the succeeding year.

Since the Scutellista is generally distributed throughout the citrus belt of Southern California, little can be gained by turning loose a half dozen specimens in a grove of 10, 20 or 40 acres where there are already many hundreds or thousands, except for the moral effect on the grower. Sometimes the scale may largely disappear the following year, and sometimes the Scutellista may be a great help in this decrease, but in such cases it is on account of those already present in the grove rather than the supposed great impetus given by the half dozen introduced. Of course the artificial introduction of Scutellista in places where they do not occur, or are not well established, should be greatly encouraged.

The good that might result from the introduction of Scutellista is often rendered negligible because the scale is not in the proper stage to be attacked. With such introductions in most places in southern California during July and August, or even later of this year, nothing was left for the Scutellista but to perish. At this season all the eggs, or nearly all, had hatched and the parasite will not oviposit on the young scales. This is true also of those already present in the grove and hundreds or thousands must perish unless they find some scale out of season with those that have been attacked. Indeed, this is the most serious matter in the whole Scutellista economy and is a great drawback to their rapid multiplication. This parasite was hardly intended to depend, exclusively on the black scale, where there is a uniform hatch of the insect. Fortunately in most parts of California, and possibly other places where the black scale occurs, there are enough of the so-called "off hatch" to maintain the parasite until the bulk of the scales are in the proper stage again.

Life History and Habits

The egg is pearly white in color, ellipto-cylindrical in shape, with tapering appendage at one end. The length of the body of the egg is about .37 mm. and the appendage about one half that length. The eggs are inserted beneath the scale, usually under the arch at the posterior end. The scale need not necessarily be in the egg stage, for eggs have been found both in the field and insectary under scales that had not yet reached the egg-laying stage. The hatching period during the summer months is 4 to 6 days.

The young larva upon hatching soon begins to feed on the eggs of the scale by sucking out their contents, or, if eggs are not present, it attacks the insect itself. Several cases have been observed where

the larva had grown to considerable size under a scale that had not yet laid eggs. It is not, therefore, strictly an egg feeder, as generally supposed, but of course eggs constitute the normal food. Larvæ have been reared from the Soft Brown scale (*Coccus hesperidum*) in which cases no eggs were consumed for this scale lays no eggs. Larvæ have also been seen feeding on others of its kind. This cannibalistic habit must be rather common for in nature cases must often occur where several eggs are deposited under the same scale. This is not usually done by the same insect but by different individuals, as explained later.

The full grown larva preliminary to pupation hollows out a cell in the old egg skins and mats them together more or less with a small amount of silk. Strands of silk are also frequently, or usually, spun from the twig to the inner edge of the scale. Whether this is done in an effort to enclose itself on all sides with a small amount of silk, or whether it is an instinctive provision to assure the old scale adhering to the twig during pupal life, or both may only be conjectured. But it is a common conclusion that old scales harboring Scutellista pupæ are not lifted from the twig so readily as those not parasitized. Black scales that have been parasitized by Scutellista are more likely to remain longer on the tree than those that are not. These may remain on the tree for two or three years in many parts of Southern California where there is but little rain or wind to dislodge them. This fact is not often taken into consideration in estimating the amount of parasitization, so that those scales with exit holes increase with each year's infestation, while those without exit holes are more likely to drop off.

The amount of food consumed or the number of eggs of the scale necessary to bring the larva to maturity varies greatly. A scale has not yet been found too small to have a Scutellista pupa. The smallest mature black scale has been found to be less than one half the size of the largest. The smallest may have a maximum of 500 eggs and the largest from 2,700 to 3,000. The size of the mature larva varies greatly, according to the abundance of eggs, and likewise the adult. Males, of course, are much smaller than the females and there seems to be a preponderance of males in the smaller scales. No eggs hatch in the case of the smaller numbers of eggs, but several hundred may hatch in the case of the larger numbers. The length of the larval period varies from 16 to 21 days during the summer season.

The mature larva is white in color, with the darker gray of the digestive tract showing through the body wall in some of the specimens. The average size of the full grown larva is about 3 mm. and the width about 1 mm. It is broadest at the head end, while there

is a gradual tapering toward the posterior end. The external mouth parts consist of a pair of sharp pointed chitinous hooks which are used for piercing the egg shell or the body wall of the scales.

The pupa is almost jet black in color, having changed very quickly from that of the white larva. The length of the pupa varies from 1.5 to 3 mm. The large scutellum extends to the posterior margin of the second abdominal segment. The duration of the pupal stage is from 16 to 19 days. The most usual number under a single scale is one, but not infrequently two are found, more rarely three, and in but one case out of several thousand scales lifted, four pupæ were found in four separate cells beneath a single scale.

The adults upon transforming from the pupa eat out a round hole usually on the dorsal surface of the scale. They may remain a short time beneath the scale before emerging, since occasionally upon lifting a scale the mature insect will be seen to escape. They have been observed to oviposit within 24 hours after emerging. The ovipositor is inserted almost invariably under the arch at the posterior tip. Sometimes two or three insertions are made and the egg deposited, all within about half a minute. Oviposition has been observed to occur under scales from which all the eggs had hatched, under scales already occupied by Scutellista larva, under scales where not enough eggs remained to bring the larva to maturity, and where the young had hatched but died before emerging. In the field oviposition has been noted where the scales had not yet reached the egg laying stage, the so-called "rubber stage," and in the laboratory under forced conditions it has occurred on scales after the first molt. Oviposition has not been observed, even under laboratory conditions, in the case of very young scales. Several eggs may be laid in succession but these under different scales. Other individuals will lay eggs under these same scales and this probably accounts for two or more larvæ under the same scale.

Mr. E. W. Rust of this laboratory has apparently determined that this insect may reproduce parthenogenetically. Mature black scales with eggs were allowed to remain for a week under cover in order to allow any chance for Scutellista eggs that might be present to hatch. In the meantime several pupæ were put each in a separate box and the adults allowed to mature. Two of these unfertilized females were placed in a vial containing a twig with a single black scale. Several days later the scale was lifted and two Scutellista eggs and four newly hatched larvæ were found. Since the eggs hatch in from 4 to 6 days, the eggs and larvæ present must have come from the Scutellista liberated. Parthenogenetic reproduction is not necessarily common for the number of the sexes is approximately equal, and often even a slight excess in favor of the males.

The length of the adult life is from 9 to 12 days. Adults died within this period whether they were confined in a pill box with no food, or under practically natural conditions. Thus far they have not been seen feeding. It is possible that they feed on the surface tissue of the orange or something else, but this has not been observed. But that little food, if any, is taken in the adult stage seems likely, from the fact that the adult life is the same whether confined without food or in the presence of its probable food supply.

The stages and abundance of Scutellista are very much dependent upon the same conditions in the scale. Since the black scale is at the height of egg laying in this section in June, it is then that Scutellista larva or pupa will be most abundant. The period of greatest emergence of adults is during July. Many fail to lay eggs at this time because the scales are too young. It is necessary to find a scale out of season with the ordinary brood which developed the Scutellista in order for eggs to be deposited and the species perpetuated.

The number of broods in a season is not well defined. One record from egg to adult will serve to indicate the length of life and duration of the different stages. Egg laid July 22; egg hatched July 27; pupated August 12; adult emerged August 26; adult died September 4. The egg period is thus 5 days, larval 16, pupal 15, adult 9, or a total of 45 days for the life cycle from the egg to the death of the adult. If the scale were in the proper stage at the end of each generation there would appear from 3 to 4 generations of the parasite during the summer months, that is from May to September inclusive, and there may be 2 or 3 generations also during the winter season, but on account of the unfavorable conditions of the scale 4 or 5 will probably be nearer the actual number.

ON SOME PHASES OF PARASITISM DISPLAYED BY INSECT ENEMIES OF WEEVILS[1]

By W. Dwight Pierce, *U. S. Bureau of Entomology, Dallas, Tex.*

In a recent article Mr. W. F. Fiske[2] has defined a certain phenomenon as superparasitism, which has hitherto been recorded by the present writer as accidental secondary parasitism.[3] In defining this

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[1]Published by permission of the Chief of the Bureau of Entomology.

[2]W. F. Fiske, Superparasitism: An Important Factor in the Natural Control of Insects. Journ. Econ. Ent., Vol. 3, pp. 88–97, February 15, 1910.

[3]W. D. Pierce. Studies of Parasites of the Cotton Boll Weevil, U. S. Bur. Ent., Bul. 73, p. 33, January 21, 1908.

phenomenon, Mr. Fiske has performed a signal service. It seems worth while to present some concrete examples which have come to the notice of the writer, in order to make this interesting phase of parasitism more widely understood. Brief perusal of the records of the Southern Field Crop Insect Investigations seems to show the existence of a number of important phases of superparasitism in addition to those brought out by Mr. Fiske's work on the gypsy moth parasites.

An effort has been made to classify the various examples which have been gathered in such a manner as to show in how many ways the parasites may interact upon each other, even in as simple a parasite problem as the boll weevil presents. There are many other branches of entomological research where parasite conditions are far more complicated than in the instances herewith cited.

Insect parasitism of weevils may be classified as follows:

1. Primary	Simple	Endoparasitism
		Ectoparasitism
	Multiple	Endoparasitism
2. Secondary	Hyperparasitism	
	Superparasitism	

These different phases may therefore be defined in couplets.

PRIMARY PARASITISM is an original parasitic attack upon a host.

SECONDARY PARASITISM covers all subsequent attacks by parasites.

SIMPLE PARASITISM is the attack by a single individual.

MULTIPLE PARASITISM is the normal simultaneous attack by a number of individuals of the same species. It is probably the result of polyembryony in many cases.

ENDOPARASITISM is the internal attack of a parasite.

ECTOPARASITISM is the external attack of a parasite.

HYPERPARASITISM is the normal attack of a parasite species upon another parasite species.

SUPERPARASITISM occurs when a normally primary parasite attacks a host already parasitized, and the result is that the latest comer generally attacks its predecessor.

Predation complicates parasitism many times and in fact brings about the same results as superparasitism; in other words, a struggle between forces working for the same end — the control of the host.

The following examples have been collected to illustrate each of these phases or their combinations:

SIMPLE ECTOPARASITISM is the commonest phase of parasitism upon external feeding weevils. Some of these parasites are quickly fatal while others are much less so. *Bracon mellitor* Say, *Catolaccus* sp.,

Cerambycobius sp., *Eurytoma tylodermatis* Ashmead and *Microdontomerus anthonomi* Crawford are normally primary ectoparasites, attacking weevils which do not enter the ground, their attack being fatal in a very short time. *Sigalphus zygobaridis* Crawford attacking *Zygobaris xanthoxyli* Pierce, *Sigalphus curculionis* Herbst attacking *Conotrachelus* sp., and probably *Eutrichosoma albipes* Crawford attacking *Auleutes tenuipes* Dietz and *Smicronyx tychoides* LeConte, are normally primary ectoparasites, attacking weevils which enter the ground for pupation, and do not kill the host until it has formed its earthen cell.

Averted simple ectoparasitism: Sometimes it happens that two different kinds of insects live in the same plant in a similar manner as *Anthonomus squamosus* LeConte and the fly, *Rhagoletis grindeliæ* Coquillett, in heads of *Grindelia squarrosa nuda*. An instance of averted parasitism occurred in the attack of this fly by *Eurytoma tylodermatis*.

Simple endoparasitism is not very common on the weevils which have been studied. The solitary hidden eggs of most weevils do not invite extensive parasitic attack; however, Girault has recorded *Anaphoidea conotracheli* Girault from eggs of *Conotrachelus nenuphar* Herbst, and *A. sordida* Girault from eggs of *Tyloderma foveolatum* Say. The larvæ are more frequently attacked. Among weevil parasites endoparasitism is displayed by *Myiophasia ænea* Wiedemann, *Ennyomma globosa* Townsend in the Tachinidæ, and by *Tetrastichus hunteri* Crawford in the Chalcidoidea, all attacking the boll weevil. Weevils of the genus Conotrachelus are attacked by *Cholomyia inæquipes* Bigot, *Metadexia basalis* Giglio-Tos, and *Myiophasia ænea* Wiedemann. The latter parasites are therefore forced to dig their way to the surface of the ground.

Multiple endoparasitism is probably the result of polyembryony in the following cases which are the only instances of multiple parasites of weevils known perfectly to us; viz., *Horismenus lixivorus* Crawford attacking *Lixus scrobicollis* Boheman, and an undescribed Tetrastichus attacking *Orthoris crotchii* LeConte. The number of Horismenus bred from a single host was very variable, being sometimes as high as 47. In both cases the parasites are internal and leave the host to pupate.

True hyperparasitism is at present unknown in the studies of weevil parasites.

Non-fatal superparasitism will be seen by the examples rendered to be much less common than the fatal. It displays several very peculiar phenomena.

In the following examples two primary simple ectoparasites, not always being of the same species, have successfully bred from a single host.

2 *Bracon mellitor* Say — 1 example.
1 ♀ *Catolaccus incertus* Ashmead, 1 ♀ *Cerambycobius cyaniceps* Ashmead — 1 example.
1 ♂ 1 ♀ *Cerambycobius cyaniceps* Ashmead — 2 examples.
2 *Cerambycobius cyaniceps* (from Lixus) — 1 example.
2 ♀ *Microdontomerus anthonomi* Crawford — 1 example.
2 ♂ *Microdontomerus anthonomi* Crawford — 1 example.
1 *Glyptomorpha rugator* Say and 1 *Cerambycobius cyaniceps* Ashmead (from Lixus) — 1 example.

An example is at hand of the breeding of two species of multiple parasites from the same host:

7 *Aphiochæta fasciata* Fallen, 2 *Aphiochæta pygmæa* Zetterstedt — 1 example.

Combined simple ecto- and multiple endoparasitism is a most peculiar phase of superparasitism.

From *Lixus scrobicollis* parasite records we obtain the following interesting records in this category; in each example all survive:

Numerous *Horismenus lixivorus* Crawford and 1 *Cerambycobius cyaniceps* Ashmead — 2 examples.
Numerous *Horismenus lixivorus* Crawford and 1 *Neocatolaccus tylodermæ* Ashmead — 1 example.
Numerous *Horismenus lixivorus* Crawford and 1 *Eurytoma tylodermatis* Ashmead — 2 examples.
8 *Horismenus lixivorus* Crawford and 1 unknown — 1 example.
47 *Horismenus lixivorus* Crawford and 1 *Cerambycobius cyaniceps* Ashmead — 1 example.

Cannibal superparasitism: It frequently occurs where parasitism is high that the duplication known as superparasitism becomes a *normal* phenomenon. The females of a given species may repeat oviposition in the same host which they have themselves formerly attacked, or which another individual has attacked. With normally solitary parasites superparasitism is then inevitable, and the second comer usually devours the first. We have a record of a boll weevil larva bearing a dead fully grown parasite larva, which bore a dead half-grown larva, which in turn bore a minute living larva, and on another part of the dead host was another minute larva which would ultimately have a struggle with the first. The egg shells present proved them all to be conspecific.

In most cases of cannabalism both individuals die but we have the following records in which one survived:

2 *Bracon mellitor* Say, 1 ♀ survives — 1 example.
2 ♂ *Cerambycobius cyaniceps* Ashm., 1 survives — 1 example.
2 *Eurytoma tylodermatis* Ashm., 1 ♀ survives — 1 example.
7 *Eurytoma tylodermatis* Ashm., 1 ♂ survives — 1 example.

The following examples in which all died show how much duplication of energy there frequently is:

2 *Catolaccus hunteri* Crawford — 7 examples.
3 *Catolaccus hunteri* Crawford — 2 examples.
4 *Catolaccus hunteri* Crawford — 1 example.
5 *Catolaccus hunteri* Crawford — 1 example.
2 *Catolaccus incertus* Ashmead — 3 examples.
3 *Catolaccus incertus* Ashmead — 1 example.
4 *Catolaccus incertus* Ashmead — 2 examples.
5 *Catolaccus incertus* Ashmead — 1 example.
6 *Catolaccus incertus* Ashmead — 1 example.
2 *Eurytoma tylodermatis* Ashmead — 7 examples.
3 *Eurytoma tylodermatis* Ashmead — 2 examples.
5 *Eurytoma tylodermatis* Ashmead — 1 example.
2 *Microdontomerus anthonomi* Crawford — 1 example.
3 *Microdontomerus anthonomi* Crawford — 1 example.
4 *Microdontomerus anthonomi* Crawford — 2 examples.
8 *Microdontomerus anthonomi* Crawford — 1 example.

MIXED SUPERPARASITISM is that phase in which two or more species are brought together upon the same host. The following records will show how common it is among parasites of the boll weevil.

We have many cases with only two parasites involved in which one individual survived. The sex of the survivors and the number of examples are given at the end of each line:

Unknown super. *Catolaccus hunteri* — 1 example.
Bracon mellitor super. unknown — 1 ♀.
Catolaccus sp. super. *Bracon mellitor* — 1 ♀.
Catolaccus hunteri super. unknown — 1 ♀.
Catolaccus hunteri super. *Bracon mellitor* — 1 ♀.
Catolaccus incertus super. *Bracon mellitor* — 2 ♀.
Cerambycobius cushmani super. *Bracon mellitor* — 8 ♂ (7), 9 ♀.
Cerambycobius cyaniceps super. unknown — 1 ♂.
Cerambycobius cyaniceps super. *Bracon mellitor* — 23 ♂ (6), 28 ♀.
Cerambycobius cyaniceps super. *Catolaccus hunteri* — 2 ♂, 2 ♀.
Cerambycobius cyaniceps super. *Catolaccus incertus* — 1 ♂, 3 ♀.
Eurytoma tylodermatis super. unknown — 1 ♂ (3), 2 ♀.
Eurytoma tylodermatis super. *Bracon mellitor* — 8 ♂ (2), 2 ♀.
Eurytoma sp. super. *Bracon mellitor* — 1 ♂.
Microdontomerus anthonomi super. unknown — 1 ♂, 1 ♀.
Microdontomerus anthonomi super. *Bracon mellitor* 4 ♂ (3), 14 ♀.
Microdontomerus anthonomi super. *Catolaccus hunteri* — 1 ♀.
Microdontomerus anthonomi super. *Eurytoma tylodermatis* — 1 ♂, 1 ♀.

The number of examples is much smaller where more than two individuals are concerned and one survives.

2 unknown, 1 dipteron (survivor) — 1 example.
2 unknown, 1 ♀ *Eurytoma tylodermatis* (survivor) — 1 example.
3 *Eurytoma tylodermatis*, 1 ♀ *Microdontomerus anthonomi* (survivor) — 1 example.
3 *Eurytoma tylodermatis* (1 ♀ survives), 2 *Catolaccus hunteri* — 1 example.
6 unknown, 1 ♀ *Catolaccus hunteri* (survivor) — 1 example.
7 *Catolaccus hunteri*, 1 *Microdontomerus anthonomi* (survivor) — 1 example.
16 unknown, 1 *Microdontomerus anthonomi* (survivor) — 1 example.

In the majority of cases studied all superparasites died. These records are here grouped according to the number of individuals concerned.

1. (Only two parasites involved.)

2 unknown — 75 examples.
Unknown and *Bracon mellitor* — 9 examples.
Unknown and *Catolaccus hunteri* — 2 examples.
Unknown and *Catolaccus incertus* — 1 example.
Unknown and *Cerambycobius cyaniceps* — 1 example.
Unknown and *Eurytoma tylodermatis* — 1 example.
Catolaccus hunteri and *Cerambycobius cyaniceps* — 1 example.
Catolaccus hunteri and *Eurytoma tylodermatis* — 2 examples.
Catolaccus incertus and *Eurytoma tylodermatis* — 1 example.
Cerambycobius cushmani super. *Bracon mellitor* — 3 examples.
Cerambycobius cyaniceps super. *Bracon mellitor* — 1 example.
Cerambycobius cyaniceps and *Eurytoma tylodermatis* — 1 example.
Eurytoma tylodermatis super. *Bracon mellitor* — 1 example.
Eurytoma tylodermatis and *Microdontomerus anthonomi* — 3 examples.

2. (Three parasites involved.)

3 unknown — 19 examples.
1 unknown, 1 *Catolaccus*, 1 *Eurytoma* — 1 example.
1 *Bracon mellitor*, 2 *Eurytoma tylodermatis* — 1 example.
1 *Catolaccus hunteri*, 2 *Eurytoma tylodermatis* — 1 example.
2 *Catolaccus incertus*, 1 *Eurytoma tylodermatis* — 1 example.

3. (More than three parasites involved.)

4 unknown — 5 examples.
1 unknown, 3 *Catolaccus hunteri* — 2 examples.
2 *Catolaccus hunteri*, 2 *Eurytoma tylodermatis* — 1 example.
5 unknown — 4 examples.
4 *Catolaccus incertus*, 1 *Eurytoma tylodermatis* — 1 example.
2 *Cerambycobius cyaniceps*, 3 *Microdontomerus anthonomi* — 1 example.
2 *Eurytoma tylodermatis*, 3 *Microdontomerus anthonomi* — 1 example.
6 unknown — 1 example.
2 *Catolaccus hunteri*, 4 *Microdontomerus anthonomi* — 1 example.
3 *Catolaccus hunteri*, 2 *Eurytoma tylodermatis*, 1 *Microdontomerus anthonomi* — 1 example.
4 *Catolaccus incertus*, 2 *Eurytoma tylodermatis* — 1 example.
7 unknown — 1 example.
6 *Catolaccus hunteri*, 1 *Eurytoma tylodermatis* — 1 example.
4 *Catolaccus incertus*, 3 *Eurytoma tylodermatis* — 1 example.
8 unknown — 1 example.
3 *Catolaccus hunteri*, 3 *Eurytoma tylodermatis*, 2 *Microdontomerus anthonomi* — 1 example.
9 unknown — 1 example.
11 *Microdontomerus anthonomi*, 1 *Cerambycobius cyaniceps* 1 example.
13 *Microdontomerus anthonomi*, 1 *Eurytoma tylodermatis* — 1 example.
16 unknown — 2 examples.
20 unknown — 1 example.
25 unknown — 1 example.

COMBINED SIMPLE ECTO- AND ENDOPARASITISM: It was frequently found that boll weevils internally parasitized by *Tetrastichus hunteri* Crawford were externally parasitized by one or more other parasites; such cases are usually fatal for both.

Tetrastichus hunteri lives, unknown external dies — 2 examples.
Tetrastichus hunteri dies, *Catolaccus hunteri* lives — 1 example.
Tetrastichus hunteri dies, unknown external dies — 5 examples.
Tetrastichus hunteri dies, *Cerambycobius cyaniceps* dies — 1 example.

Tetrastichus hunteri dies, *Cerambycobius cyaniceps* and unknown external both die — 1 example.
Tetrastichus hunteri dies, 3 unknown external die — 1 example.
Tetrastichus hunteri dies, 2 *Catolaccus hunteri* and 4 unknown external, all die — 1 example.

Predation upon Parasites

As was remarked on a preceding page predation frequently complicates parasitism and renders it of no avail. Of course many kinds of predation are accidental but the following examples will illustrate some phases which greatly resemble superparasitism because the attack is by larvæ:

Unknown Coleopteron super. *Bracon mellitor* — 1 example.
Unknown Coleopteron super. *Catolaccus hunteri* — 1 example.
Unknown Coleopteron super. *Eurytoma tylodermatis* — 1 example.
Catorama sp. super. *Bracon mellitor* — 1 example.
Catorama sp. super. *Cerambycobius cushmani* — 1 example.
Hydnocera pubescens super. unknown — 1 example.
Hydnocera pubescens super. *Bracon mellitor* — 11 examples.
Hyndocera pubescens super. *Catolaccus incertus* — 2 examples.
Hydnocera pubescens super. *Cerambycobius cyaniceps* — 1 example.
Hydnocera pubescens super. *Eurytoma tylodermatis* — 1 example.
Catorama sp. super. *Cerambycobius cushmani* super. *Bracon mellitor* — 1 example.
Unknown predator super. ♀ *Cerambycobius cyaniceps* super. *Bracon mellitor* — 1 example.

In the following examples the predation is by adults and is less apparently similar to superparasitism although the results are identical:

Unknown predator super. *Catolaccus hunteri* — 1 example.
Unknown predator super. *Catolaccus incertus* — 1 example.
Ants super. unknown parasite — 1 example.
Ants super. *Eurytoma tylodermatis* — 1 example.
Mites super. *Bracon mellitor* — 1 example.
Cathartus cassiæ super. unknown — 2 examples.
Cathartus cassiæ super. *Bracon melitor* — 1 example.
2 *Cathartus cassiæ* super. *Catolaccus hunteri* — 1 example.
Solenopsis geminata super. *Bracon mellitor* — 1 example.

Summary: As the large number of records given herewith makes it difficult to compare the different phases described, the following summary has been compiled:

Simple ectoparasitism: normal — the vast majority of examples.

Averted simple ectoparasitism — 1 example.

Simple endoparasitism: normal — only common in certain sections.

Multiple endoparasitism: normal — very common on weed stem weevils.

True hyperparasitism: not recorded.

Non-fatal simple superparasitism involving two individuals — 8 examples.

Non-fatal multiple superparasitism involving several individuals — 1 example.

Combined simple ecto- and multiple endoparasitism (non-fatal) — 7 examples.

Cannibal superparasitism with one survivor — 4 examples.

Mixed superparasitism involving only two individuals with one survivor — 142 examples.

Mixed superparasitism involving several individuals with one survivor — 7 examples.

Combined simple ecto- and endoparasitism with one survivor — 3 examples.

Fatal cannibal superparasitism — 34 examples.

Fatal mixed superparasitism involving two individuals — 102 examples.

Fatal mixed superparasitism involving several individuals — 54 examples.

Combined simple ecto- and endoparasitism (fatal) — 9 examples.

Total non-fatal superparasitism — 16 examples.

Total superparasitism with one survivor — 156 examples.

Total fatal superparasitism — 199 examples.

Predation by larvæ upon primary parasites — 21 examples.

Predation by larvæ upon superparasites — 2 examples.

Predation by adults upon primary parasites — 10 examples.

A superficial study of the examples given would perhaps give the idea that superparasitism is a serious drawback to control by parasites. It must not be forgotten that the many thousands of examples of pure simple parasitism have been omitted from the discussion. The writer's observations upon this most interesting phenomenon are that superparasitism seldom if ever occurs until the percentage of parasitism has become comparatively high. From the point where superparasitism does begin, however, it very rapidly acts as a check upon parasite increase until it almost completely stops the control at 75 per cent. Owing to the many other elements of weevil control it is seldom possible for parasitism to reach much above 45 or 50 per cent *of the total number of weevils in the field.* The other factors may be counted upon to average about 50 per cent of the total. With very favorable conditions the parasites sometimes reach as many as 75 per cent of the weevils.

ON THE LIFE HISTORY OF THE ALFALFA LEAF-WEEVIL

By E. G. Titus, *Logan, Utah*

The alfalfa leaf-weevil (*Phytonomus murinus* Fab.) now occurs in at least eight counties in Utah.

In 1908 the distribution was probably limited to 100 square miles in Salt Lake and Summit counties. It now covers an area eighty miles long, north and south, by seventy-five miles east and west or a gain in 1909 and 1910 equal to sixty times the previously infested area.

The present *known* infested area covers all of Salt Lake and Davis counties, north half of Utah county, southern part of Weber, northeastern Tooele, northwestern Wasatch, eastern Summit and the south half of Morgan county.

Specimens have been taken from trains passing thru Box Elder and Cache counties, these two counties forming part of the north boundary of the state. It is not unlikely that there are isolated colonies breeding in these and other counties. In Summit county it has nearly or quite reached the Wyoming line.

There are so many means of distribution, such as the spring and summer flights, railroad and wagon road transportation, carriage in fruit packages, household goods and other packages, that it is certainly a question of but a short time before the species will be present in other states.

Food Plants

It has been found feeding and breeding on seven species representing three genera of plants: alfalfa (*Medicago sativa*), burr-clover (*M. lupulina*), white sweet clover (*Melilotus alba*), yellow sweet clover (*M. officinalis*), red clover (*Trifolium pratense*), white clover (*T. repens*), alsike clover (*T. hybridum*) and crimson clover (*T. incarnatum*).

Several species of clovers have been described from the Rocky Mountain region but these seem to be rather rare and so far the weevil has not been found attacking them.

The wild sweet pea (*Lathyrus venosus*) is not uncommon thruout the state, but even where growing beside infested alfalfa plants it has not been attacked.

Failure has resulted from attempts to breed the weevils in captivity on hairy vetch (*Vicia villosa*) and buffalo pea (*Astragalus utahensis*). Adults are often found hibernating beneath the leaves of this latter plant and in captivity would occasionally eat small pieces from the leaves.

The species certainly prefers alfalfa to any other food plant so far recognized. Its next choice appears to be burr-clover (also a Medicago), closely followed by white sweet clover. Its presence on other clovers is rather rare, and it is unusual to find burr- or white sweet-clover infested early in the year.

Broods

There is evidently but one brood of the insect, but as the season advances it becomes more and more difficult to distinguish between specimens of over-wintering weevils and weevils that issued during the season. The length of life of the adult cannot be definitely stated even in months. We have kept adults from the time they issued in May until a year from the following November, though it is probable that this is an unusually long period for them to live.

Copulation has been noticed of newly-issued males with females of the previous year in early July; and very soon afterward between specimens of the year, while mating of the over-wintering specimens appear to continue from spring to fall. The males have the same habit as those of *P. punctatus*, reported by Dr. Folsom[1] in that they follow the females around and mate a number of times.

Eggs and young larvæ found late in the fall, September to November, are probably progeny of over-wintering females and not members of a second brood. It is probable that many of these larvæ perish on account of unsuitable weather conditions but I have had adults issue as late as November 28.

Hibernation

Many of the adults go into hibernation early in the fall, even as early as the first week in August. Tho many of these come out to feed at times, it has been noticed that even a passing cloud will drive them to shelter. A cold rain following a hot day seemed to be quite destructive so that it appears they are very susceptible to climatic conditions during this period. Certainly a large number of beetles die during the summer and fall of the year they are bred.

A small amount of shelter seems to suffice for winter protection. Burlap bands on apple trees are favorite places and where such bands were placed on fence-posts along an alfalfa field many weevils were collected. They do not appear to be gregarious in their hibernating habits but each seeks its own shelter under grass, bark, in hollow trees, crevices in thé ground, in buildings or almost any protected spot.

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[1]1909: Folsom: Ill. Agr. Exp. Sta. Bul. 134, Apr., p. 162.

Spring Feeding Habits

They, appear again at the first approach of spring and begin feeding on the alfalfa, making punctures in the stalks. This is very different from the summer and fall feeding when they rasp the epidermis from the stalk and slit the leaves into ribbons.

The feeding-puncture is irregularly oval in outline and usually made by slitting and gnawing the cavity. The weevil apparently gouges out its food and will stand for some time working small pieces loose; it will then withdraw the beak, chew and swallow the food and again return to the puncture. The injury is very often severe, especially to young stalks which are so deeply cut that many wilt and break off. During the warmer part of these early spring days weevils have been noticed mating, and egg-laying certainly commences soon after they come from hibernation. The spring flight begins with the first continued warm weather.

Oviposition

The eggs are at first laid singly on the plant; in the buds, axils of the leaves, on the stalk or beneath the leaf sheath. In this latter case the ovipositor is inserted thru the sheath, the egg being placed inside in contact with the stalk and not in the tissue of the leaf as reported for *P. nigrirostris* by Wildermuth.[1] Two to three weeks after egg-laying commences the female begins ovipositing in the stalks and this form of oviposition becomes more common as the season advances.

The egg-punctures are usually clean-cut and almost circular in outline. The weevils seen making these punctures made but one cut with the beak. Standing lengthwise of the stem, head downward, the beak was inserted at an angle slightly toward the base of the stalk and given a steady pull up and in, thus making an elongated slit inside the stem, both below and above the puncture. The beak was then withdrawn and the insect either turned around or walked forward and pushed her ovipositor into the puncture. From thirty seconds to two minutes were occupied in laying the egg, the ovipositor being withdrawn after each egg-deposit.

Sometimes a puncture is filled with eggs until they project from the aperture. When the female does not fill the puncture with eggs she sometimes plugs it with a small ball of excreta or a little mass of epidermis gnawed from the stalk. Sometimes before inserting the beak to make the puncture she first gnaws away the epidermis.

Egg-punctures in a slender stalk may cause the leaves to wilt and the stalk to die and the same thing occurs when too many egg-punctures are made in a larger stalk.

[1] 1909: Webster: U. S. D. A. Bur. Ent. Bul. 85, pt. 1, p. 9.

The following tables furnish data relating to feeding-punctures, egg-punctures and eggs found in each stalk in single clumps of alfalfa at different dates in 1909 and 1910. It is believed they were fairly typical of the conditions occurring at those dates.

TABLE 1

14 March, 1910—16 stalks in one clump

No. of stalk	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Totals
Feeding-punctures	2	4	3	0	4	2	4	2	4	3	4	0	5	3	2	2	44
Egg-punctures	1	0	0	2	0	1	0	1	0	1	0	1	0	1	0	1	9
Eggs found in each	8	...	...	4	...	7	...	7	....	10	....	9	....	5	0	8	......
puncture	...	...	...	2	...	...	...	...	....	....	....	....	....	....	....	....	......
Total eggs to stalk	8	0	0	6	0	7	0	7	0	10	0	9	0	5	0	8	60

TABLE 2

9 Apr. 1909—18 stalks in one clump

No. of stalk	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Totals
Feeding-punctures	2	3	1	0	0	5	4	4	3	3	2	3	6	4	5	3	0	2	50
Egg-punctures	1	1	1	0	0	0	3	0	2	2	1	0	0	0	1	0	0	0	12
Eggs found in each	7	8	4	...	...	...	5	...	11	9	6	...	...	...	8	...	...	...	......
puncture	...	...	...	...	...	...	9	...	2	5	...	...	...	...	...	...	...	...	......
	...	...	...	...	...	...	4	...	...	..	...	...	...	...	...	...	...	...	......
Total eggs to stalk	7	8	4	0	0	0	18	0	13	14	6	0	0	0	8	0	0	0	78

TABLE 3

3 Apr. 1910—16 stalks in one clump

No. of stalk	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Totals
Feeding-punctures	3	0	4	3	3	2	5	0	0	5	6	2	4	4	3	3	47
Egg-punctures	1	1	0	3	2	2	3	0	2	0	3	4	0	3	2	4	30
Eggs found in each	1	2	...	7	10	6	5	....	7	....	7	3	....	4	6	2	......
puncture	..	...	...	6	1	4	4	....	4	....	4	5	....	2	7	2	......
	..	...	...	4	...	...	2	....	....	....	3	7	....	4	....	3	......
	..	...	...	...	...	...	...	....	....	....	....	3	....	....	....	1	......
Total eggs to stalk	1	2	0	17	11	10	11	0	11	0	14	18	0	10	13	8	126

TABLE 4

18 April 1910—32 stalks in one clump

No. of stalk	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	Totals
Feeding punctures	1	2	1	4	1	2	1	3	1	0	2	1	0	0	0	1	0	4	0	2	0	2	0	2	5	0	3	0	2	0	0	0	40
Egg-punctures	8	18	6	0	4	0	4	0	8	0	4	0	3	0	1	6	2	9	12	11	0	4	6	3	6	8	7	0	0	2	0	0	132
Eggs found in each punc-	4	8	1	..	11	..	22	..	7	..	7	..	11	..	18	2	10	8	6	12	..	11	2	1	4	1	8	..	..	11	..	..	......
ture	18	2	1	..	13	..	3	..	11	..	8	..	2	..	..	6	5	14	15	3	..	12	11	6	3	6	2	..	..	9	..	..	......
	6	9	8	..	8	..	5	..	14	..	4	..	6	..	..	7	..	7	12	7	..	14	3	4	14	8	9	..	..	..	..	..	......
	4	14	11	..	4	..	6	..	9	..	9	..	..	..	..	6	..	11	8	4	..	8	8	..	11	10	6	..	..	..	..	..	......
	1	5	5	..	..	..	..	..	8	..	..	..	..	..	..	8	..	10	4	8	..	..	5	..	2	11	5	..	..	..	..	..	......
	12	2	9	..	..	..	..	..	6	..	..	..	..	..	..	4	..	17	7	9	..	..	4	..	9	7	4	..	..	..	..	..	......
	5	2	..	..	..	..	..	..	4	..	..	..	..	..	..	..	..	6	15	2	..	..	..	..	..	4	14	..	..	..	..	..	......
	6	6	..	..	..	..	..	..	3	..	..	..	..	..	..	..	..	9	11	..	..	..	..	..	..	12	..	..	..	..	..	..	......
	..	4	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	5	1	..	..	..	..	..	..	..	..	..	..	..	..	......
	..	3	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	9	9	..	..	..	..	..	..	..	..	..	..	..	..	......
	..	12	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3	..	..	..	..	..	..	..	..	..	..	..	..	..	......
	..	4	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	......
	..	7	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	......
	..	6	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	......
	..	3	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	......
	..	6	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	......
	..	10	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	......
	..	11	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	......
Total eggs to stalk	56	114	35	0	36	0	36	0	62	0	28	0	19	0	18	33	15	84	95	55	0	45	33	11	43	59	48	0	0	20	0	0	945

TABLE 5

2 May 1909—26 stalks in one clump

No. of stalk	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	Totals
Feeding-punctures	4	2	5	3	0	2	1	5	4	1	6	0	3	3	2	4	2	2	3	4	2	3	6	5	4	4	80
Egg-punches	2	8	0	4	5	4	0	3	1	3	7	4	3	6	3	2	5	1	1	0	8	4	2	3	0	5	84
Eggs found in each	3	14	..	8	12	1	..	9	12	8	11	4	7	8	1	9	8	4	5	..	4	2	6	4	..	9	...
puncture	13	9	..	3	4	5	..	8	..	4	6	7	8	4	3	8	3	..	..	..	6	3	1	7	..	8	...
	..	3	..	3	2	4	..	10	..	3	10	4	6	2	9	..	12	..	..	..	5	5	..	6	..	13	...
	..	7	..	1	3	6	..	..	..	..	8	5	..	6	..	..	4	..	..	..	3	11	..	..	..	4	...
	..	2	..	..	3	..	..	..	..	..	4	..	..	9	..	..	5	..	..	..	8	..	..	..	..	7	...
	..	3	..	..	..	..	..	..	..	..	5	..	..	4	..	..	..	..	..	..	1	..	..	..	..	..	...
	..	4	..	..	..	..	..	..	..	..	2	..	..	..	..	..	..	..	..	..	4	..	..	..	..	..	...
	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	9	..	..	..	..	..	...
Total eggs to stalk	16	43	0	15	24	16	0	27	12	15	46	20	21	33	13	17	32	4	5	0	40	21	7	17	0	41	484

TABLE 6

25 May 1909—14 stalks in one clump

No. of stalk	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Totals
Feeding-punctures	3	1	5	2	1	0	1	0	3	0	3	1	2	1	23
Egg-punctures	6	1	3	2	0	0	4	5	0	0	9	4	3	1	38
Eggs found in each	5	9	3	5	....	....	6	5	....	....	7	7	5	26	......
puncture	4	....	4	11	....	....	4	3	....	....	6	11	6	....	......
	9	....	3	....	....	....	10	4	....	....	11	2	4	....	......
	16	....	....	....	....	....	2	5	....	....	2	3	....	....	......
	2	....	....	....	....	....	....	1	....	....	4	....	....	....	......
	4	....	....	....	....	....	....	....	....	....	1	....	....	....	......
	....	....	....	....	....	....	....	....	....	....	5	....	....	....	......
	....	....	....	....	....	....	....	....	....	....	6	....	....	....	......
	....	....	....	....	....	....	....	....	....	....	8	....	....	....	......
Total eggs to stalk	40	9	10	16	0	0	22	18	0	0	50	23	15	26	229

TABLE 7

21 May 1910—9 stalks in one clump

No. of stalk	1	2	3	4	5	6	7	8	9	Totals
Feeding-punctures	4	1	5	6	4	1	0	3	2	26
Egg-punctures	2	3	2	7	4	4	6	8	8	44
Eggs found in each puncture	11	8	1	8	5	1	9	14	16	......
......	9	16	1	6	2	3	11	15	4	......
......	....	4	....	14	11	9	8	3	3	......
......	....	....	....	3	10	6	7	2	11	......
......	....	....	....	17	....	....	10	1	9	......
......	....	....	....	9	....	....	1	1	2	......
......	....	....	....	8	....	....	....	6	5	......
......	....	....	....	....	....	....	....	8	8	......
Total eggs to stalk	20	28	2	65	28	19	46	50	58	316

TABLE 8

18 June 1910—21 stalks in one clump

No. of stalk	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	Totals
Feeding-punctures	2	0	2	2	3	0	1	1	1	0	2	1	2	1	0	1	2	2	1	1	3	28
Egg-punctures	1	2	0	3	1	0	2	0	1	2	0	2	2	2	1	0	2	1	0	1	1	24
Eggs found in each puncture	11	2	..	2	4	..	4	..	4	3	..	2	4	9	3	..	8	6	..	4	5	......
......	..	4	..	4	..	..	3	..	..	3	..	4	3	4	..	..	4	..	..	..	..	......
......	..	..	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	......
Total eggs to stalk	11	6	0	8	4	0	7	0	4	6	0	6	7	13	3	0	12	6	0	4	5	102

TABLE 9

6 July 1909—18 stalks in one clump

No. of stalk	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Totals
Feeding-punctures	2	0	0	0	0	0	0	1	2	2	1	1	2	0	0	0	0	1	12
Egg-punctures	1	1	1	0	2	1	1	1	1	0	1	0	1	0	0	0	0	1	16
Eggs found in each	7	14	16	...	9	4	8	7	5	0	12	0	8	...	...	...	...	2	......
puncture	...	...	...	...	11	...	...	...	...	...	...	...	...	...	...	...	...	...	......
Total eggs to stalk	7	14	16	0	20	4	8	7	5	0	12	0	8	0	0	0	0	2	93

TABLE 10

7 July 1910—20 stalks in one clump

No. of stalk	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Totals
Feeding-punctures	1	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	1	0	0	0	5
Egg-punctures	1	0	0	1	0	0	0	1	0	0	1	0	1	0	0	1	0	0	0	0	6
Eggs in each puncture	9	0	0	3	0	0	0	8	0	0	7	0	4	0	0	2	0	0	0	0	33

The season of 1910 was three to four weeks in advance of 1909 as has been graphically shown in a recent bulletin by the author.[1] Hence tables for 9 Apr. 1909, and 14 Mch. 1910, represent practically equivalent times in the two years so far as the alfalfa-growth and life-history of the weevil are concerned.

In the same manner 2 May 1909 and 3 April 1910, 25 May 1909 and 18 April 1910, and 6 July 1909 with 18 June 1910. It will be noticed with these last two dates mentioned that the comparison with 7 July 1910 shows that the seasons were by that time more nearly equal. After early July both egg and feeding-punctures are very rare. The adults that are still laying eggs evidently deposit them singly as they did at the beginning of the season.

Early in the spring there are many more feeding-punctures than egg-punctures and it is not until the adults have been laying eggs for several weeks that they bring the number of egg-punctures up to an equality. As the season advances the adults feed more and more on the leaves and epidermis of the stalk and make less feeding-punctures, so that the final relation is nearly equal.

The maximum number of feeding-punctures to any stalk does not go far above the average, although as many as six were counted several times. Eighteen egg-punctures in one stalk, even in a large stout stalk as this one happened to be, fairly riddled the stalk and it had broken down. Twenty-six eggs hardly crowded the stalk they were in; it was large and somewhat hollow and the female could have deposited more so far as space was concerned but she instead plugged up the hole with excreta.

After a few weeks of strenuous and rapid egg-laying eggs are again laid sparingly for an indefinite period, certainly until late in October and perhaps until complete hibernation begins. Over-wintering females were examined in early November and found to still contain a number of well-developed eggs.

[1]1910: Titus: Utah Agr. Exp. Sta. Bul. 110. Charts I and II.

TABLE 11

Final totals and averages

1909	No. of stalks in clump	Feeding-punctures	Egg-punctures	Eggs in clump	Relation of Feeding-punctures to egg-punctures	Average feeding-punctures to stalk	Average egg-punctures to stalk	Average eggs to egg-punctures	Average eggs to stalk
9 Apr.....	18	50	12	78	4.1 to 1	2.77	.66	6.50	4.30
2 May....	26	80	84	484	1 to 1.05	3.07	3.23	5.76	18.61
25 May....	14	23	38	229	1 to 1.64	1.64	2.71	6.03	16.70
6 July....	18	12	16	93	1 to 1.33	.66	.88	5.81	5.16
Totals.....	76	165	150	884	1 to 1.1	2.17	1.93	5.89	11.63
1910									
14 Mch....	16	44	9	60	4.9 to 1	2.75	.56	6.60	3.75
3 Apr.....	16	47	30	126	1.59 to 1	2.93	1.87	4.20	7.87
18 Apr.....	32	40	132	945	1 to 3.3	1.25	4.12	7.16	29.50
21 May....	9	26	44	316	1 to 1.65	2.88	4.88	7.18	35.10
18 June....	21	28	24	102	1.17 to 1	1.33	1.14	4.25	4.85
7 July....	20	5	6	33	1.2 to 1	.30	.25	5.50	1.65
Totals.....	114	190	245	1582	1.28 to 1	1.66	2.15	6.46	13.96
Totals..... 1909–10 ...	190	355	395	2466	1.11 to 1	1.81	2.07	6.24	12.98

Notes on Stages

Egg: The egg is oval, rounded at the ends and when first deposited is lemon-yellow in color, 0.55 mm. to 0.65 mm. long and 0.32 mm. to 0.38 mm. wide. Two to four days after being laid, a dark spot appears at one end and as incubation progresses, this spot enlarges, the egg becoming somewhat paler on the other portions. Under the microscope the surface of the egg appears very slightly roughened and sculptured with hexagonal depressions. At one end this hexagonal sculpturing is somewhat drawn out until it appears like striæ. The incubation period varies from seven to sixteen days, having an average of about ten days.

Hatching Record

Table 12 shows period of incubation for 1139 eggs taken at different periods during 1909 and 1910.

TABLE 12

Date laid	Number of eggs	Days of incubation										Failed to hatch
		7	8	9	10	11	12	13	14	15	16	
6 March.	5	3	2	..	..	..	..	..	..	..	..	0
8 March.	30	..	5	..	9	2	..	..	..	..	..	14
21 March.	112	..	9	6	74	8	1	1	1	..	..	12
22 March.	86	1	8	32	34	..	1	..	..	..	..	10
30 March.	27	..	..	..	2	19	4	..	..	..	..	2
9 April ..	38	..	1	..	30	5	..	..	..	..	..	2
15 April..	7	..	..	..	..	..	..	1	4	..	..	2
16 April..	60	..	2	11	28	..	9	..	..	..	..	10
18 April ..	140	4	7	14	76	27	8	1	..	..	..	3
19 April ..	19	..	5	5	4	3	..	..	..	..	..	2
23 April ..	246	..	..	8	86	92	8	4	8	4	4	32
25 April ..	138	..	..	15	82	22	10	..	..	..	..	9
10 May ..	56	..	..	..	20	20	..	..	..	..	..	16
20 May ..	27	..	..	14	9	..	..	..	..	..	..	4
25 May ..	33	..	7	5	..	..	..	..	..	..	..	11
31 May ..	46	..	9	9	22	2	..	..	..	..	..	4
10 June ..	50	..	..	28	20	..	..	2	..	..	..	0
15 June ..	16	..	..	9	4	..	..	..	1	..	..	2
24 June ..	13	..	..	..	..	..	..	4	1	..	..	8
	1139	8	55	156	500	200	41	13	15	4	4	143

Average hatching period = 10.22 + days.

LARVA: The larva does not cut an opening in making its exit from the shell, but by muscular contractions, rolling and twisting inside the shell, they obtain sufficient pressure to burst through the exceedingly thin membrane, which becomes brittle about hatching time.

The larva upon first hatching is 1.4 mm. to 1.5 mm. long and 0.35 mm. wide, and has the head shield dark, with only a faint trace of the inverted "Y" on the face. The remainder of the body is pale dirty yellow with the black spots on the segments showing distinctly. The hairs on the anal segments are much longer than those on the other portions of the body and are enlarged at the tips. The white median stripe on the dorsal surface is faintly indicated.

The larva when five to six days old sheds its skin and passes into the *second stage*, the head at this time becoming distinctly darker and the inverted "Y" on the face a dirty white. The white dorsal stripe

is very distinct, the remainder of the larva being green in color, somewhat lighter than that of the alfalfa on which it is feeding. The length of the larva in this stage is 3.2 mm. to 4.8 mm. by 0.7 mm. to 1.1 mm. wide.

With the *third moult* the larva becomes still darker green, the dorsal line almost pure white, an indistinct white stripe on each side of the body, and the white inverted "Y" on the face distinct. In this third stage, the length varies from 5.5 mm. to 9.2 mm. by 1.25 to 2.25 mm. wide (near the center of the body).

COCOON: When full grown, the larvæ either crawl or drop to the ground, usually the former, spinning their cocoons in the dead leaves or other rubbish there present. When there is short dead alfalfa present, such as that injured by frost, the cocoons may be found in the dead leaves as high as six inches from the ground.

The cocoon is globular, 5 mm. to 8 mm. in diameter, and is composed of a rather coarse network of pure white threads. The larva, in spinning this cocoon, at first curls into the same posture in which it usually feeds, and begins to work a mass of threads on one side and partly beneath it; later working its way into this small network and then gradually carrying the network over from one side to the other, and working in the cross threads connecting these portions. While the larva is spinning the cocoon it often curls its anal end to the mouth apparently to secure some secretion. Cocoons are usually globular, especially those made in a curled leaf, but are often made to fit the curl of the leaf. The larvæ take from ten to twenty hours to spin a cocoon, and usually do not moult into the pupa stage for from thirty-six to seventy-two hours after the cocoon is formed.

PUPA: The newly formed pupa is pale green, the eyes somewhat darkened, the posterior end of the femora, and the anterior end of the tibiæ rather dark. The abdomen has a pale dorsal line, and bears a number of hairs at the extremity. There are a series of setæ with enlarged ends on each dorsal segment, but apparently few setæ on the ventral side. The length of the pupal stage averages about eight days.

MOULTING: The larvæ in all stages seem to have the same general process of moulting. This casting off of the skin is rather a slow process. The first evidence is the slight shortening of the larva, soon followed by the splitting of the head plate, beginning at the center of the inverted "Y." This split increases in three directions along the inverted "Y," the parts rolling back and allowing the head to be protruded, the split then spreads a short distance down the back, rarely more than two segments, the larva working its way out through this opening. The cast skin soon dries and shrivels up, so that it is

almost impossible to find it. In its last stage, the larva when changing into the pupa, casts the skin in like manner.

ADULTS: The adults are oval in shape and when freshly emerged are pale brown with a distinct darker line extending centrally down the back. They harden in from one to three days depending somewhat upon the amount of sunshine present when they are developing; then cut their way out of the cocoon, usually at one end, crawl up an alfalfa stalk and begin feeding.

Late in the summer some of the hairs and scales get rubbed off, causing the weevil to appear much darker in color. Before the following spring is passed many have lost nearly all the hair and brown scales and appear black with small irregular gray spots on the elytra.

A detailed description of the adult has already been published.[1]

An examination of the type of *Phytonomus castor* Lec. shows that that species is not identical with nor even scarcely similar to *P. murinus* Fab.

CODLING MOTH CONTROL IN CALIFORNIA

By C. W. WOODWORTH

The recent Apple Show held at Watsonville, California, has not only the distinction of being the greatest exhibit in the history of apple growing, but marks a significant accomplishment in economic entomology. Watsonville is by far the greatest shipping point for apples in the world, sending out now about sixty cars per day, and the season's crop will be over 4,000 car loads. Only during the last eight years has there been any appreciable amount of spraying for codling moth. Through the efforts of the Experiment Station of the University of California the local difficulties have been overcome, and spraying may be said to have been placed on a practical basis only four years ago. Each year has seen an extension of spraying, until during the present season over sixty tons of arsenate of lead have been used in the Pajaro Valley on about 95% of the acreage in apples, all of it within ten miles of the city of Watsonville.

Spraying is almost entirely done with high pressure outfits, and there are certainly more power-spray outfits in this region than in any other fruit section. The complaint is not infrequently made in the East that growers will not carry out the suggestions of entomologists. This valley furnishes a conspicuous example of "applied" entomology. Most Western entomologists feel that their work is

[1]1909: Titus: Journ. Ec. Ent. v. 2, p. 151.

done only when their methods become the regular practice of the growers.

The difficulties met with in the Pajaro Valley in spraying for codling moth have never been discussed except locally, and may be of interest to Eastern entomologists.

Before the investigation was taken up at Watsonville many complaints came to the Department of the burning produced by Paris green and gave occasion for the study of the greens on the market in the state, reported in Bulletin 126, in which it was shown that much of that material contained water soluble arsenic. The outcome of this study was a law defining the amount of free arsenic permissible in Paris green which was also adopted in other states and which has resulted in improving the foliage safety of Paris green all over the United States.

It was soon found that the climate about Watsonville and not the free arsenic in Paris green was the determining factor in the problem in that region.

The Pajaro Valley opens out on Monterey Bay and lies opposite the Pecheco Pass. The cold winds from the ocean blow across this valley to replace the heated air of the great San Joaquin Valley, just as the winds sweep through the Golden Gate at San Francisco towards the Sacramento Valley. In consequence there are almost daily fogs from the ocean every evening during all the summer. The continual drenching of the trees by these fogs hydrolizes almost all arsenicals, setting free the acid, and after two years of experiment involving losses of thousands of dollars in some orchards on account of arsenic injury to foliage, Paris green had to be discarded entirely.

During the third year of the investigation it was also clearly seen that none of the commercial brands of arsenate of lead could be safely used in the Valley and that and the following years hundreds of arsenicals were made up and tested and the solution of the problem finally came from the discovery that certain samples of lead arsenate, both as obtained on the market and made up in the laboratory did not injure foliage, and that these samples were distinguishable by the fact that they contained no arsenic acid soluble in ammonia, that is, they consisted of a saturated lead salt. Nearly always by the ordinary methods of manufacture an arsenate of lead consists of an acid salt or a mixture of an acid and a basic arsenate of lead.

Two of my assistants undertook to work out, as a private venture, a method of manufacture by which a uniform product of this character could be obtained. They were entirely successful and organized the California Spray Chemical Company, largely financed by local orchardists, the product of which has contributed in no small degree to the final success of the effort to control this insect.

Besides the smaller experiments many tons each of such good commercial brands of arsenate of lead as Swift's, Lavenburg's and Sherwin-Williams' have been tried in the Valley and in each case with disastrous results.

Not only does the control of the codling moth require a special kind of lead arsenate, but the spraying program presents striking peculiarities.

At this time when such good results are reported as coming from a return to the old idea of a single thorough blossom-cup spraying, and some entomologists are contending that all later sprayings should be eliminated, it may come as a surprise to some that the Watsonville spraying program, which, in the hands of our best orchardists gives as good results as are obtained anywhere, absolutely ignores the blossom-cup work.

A small portion of the valley is naturally immune. The portion between Watsonville and the sea is affected so early by the cold ocean winds that the moth rarely flies. At Watsonville often for a month at a time no insects of any kind are seen about electric lights. These cold winds make the Pajaro Valley produce winter apples along the seashore side by side with oranges, grape-fruit and lemons. While in most of the valley the codling moth flies often enough to lay its full quota of eggs, still its life history and the growth of the tree are profoundly modified. Thus the blossoming period extends over such a long period that the first fruit set usually are advanced so far as to render the poisoning of the cup impossible before half of the buds are open. At least three sprayings would be necessary if one wanted to fill all the blossom cups. Likewise the moth is very irregular in appearing in the spring, the emergence of overwintering individuals requiring three months from the first to the last,—more than enough time for a full generation of the more precocious to develop.

The delayed appearance of the moths in the spring results in the great majority of individuals attacking the fruit after it is already well advanced, and a very small per cent of the entrances are in the blossom cup. No real blossom-cup spraying has ever been done in the Pajaro Valley except in our experiments and they showed no results sufficient to justify the recommendation of the method.

The spraying program usually begins with an application about the time the last blossoms appear. This is usually long after the calyx lobes of all the fruit that will set have closed. This spray may be followed by one or two applications at intervals of a month or six weeks, the number varying with the season and the portion of the valley.

These sprayings simply reduce the number of worms that may attack the crop later. The first generation of worms are not con-

sidered as having any direct effect on the crop since the infested apples either drop or are removed at thinning.

Many of our orchardists make no further sprayings, but almost always to their loss. The best orchardists begin a campaign of one to three sprayings, beginning about the middle of August. There will undoubtedly be an improvement in this matter during the next year or two. Probably the amount of poison used in this section will ultimately be over a hundred tons.

Over 1,600 barrels of commercial lime-sulfur solution were used during the past winter for San José scale, and this material is now being produced in the local factory with a density of 36 degrees Beaumé, which is considerably stronger than anything in the market in the East.

There is very little scab and scarcely any use of Bordeaux mixture; there is beginning to be a little iron sulphid used with the lead for mildew and occasionally zinc arsenate replaces the lead for the first spraying where the tussock moth must be dealt with.

The minimum sprayings that give good results in any part of the Valley are three, two for the first brood and one in August, and the maximum is six, three for the spring and three in the summer, and except for the early spring applications must be a strictly neutral arsenate of lead, one containing no ammonia soluble arsenic.

The Common Name of the Black Scale (*Saissetia oleæ* Bern).—In Vol. II, No. 6, of this Journal Mr. J. G. Sanders gives the common name of *Saissetia oleæ* Bern. as the "Olive Scale." He says, "the popular name 'Black Scale' has been applied to this species, but rather incorrectly, since it is usually very dark brown; the above name should be applied properly to *Saissetia nigra*, which in the adult female stage usually becomes truly black."

This brings up the question of the real usefulness of common names for insects. It is true that from its specific name "*oleæ*" and also its avidity to attack the olive it should be called the "Olive Scale." But since the name "Black" has become so well established, and, moreover, has been the name officially adopted by the Association of Economic Entomologists, it hardly seems wise to change it at this late date. Common names are useful chiefly to growers and others who are not entomologists. Entomologists in most cases are as familiar with the scientific name as the common name, and there is much less chance for confusion regardless of how appropriate a common name may be.

Saissetia oleæ as an economic insect in the United States is most important in California, and particularly in the southern California citrus belt. Here every grower of citrus trees knows it as the Black Scale and it would lead to needless confusion to attempt to call it anything else. On the other hand, *Saissetia nigra* Nietn. is not an economic pest anywhere in the United States, and it is of little consequence whether it has any common name at all. From the specific name "*nigra*" it could of course be appropriately called the Black Scale. But since common names are largely applied to insects of economic importance it would be likely to lead only to confusion to include the entire list of insects. While the Black Scale may not always be black, it is blacker than any others of economic importance associated with it, and to change so well established a name on a mere shade of color hardly seems justifiable. H. J. Quayle.

RECENT EXPERIMENTS WITH THE CODLING MOTH

By E. P. Felt, *Albany, N. Y.*

Last year we summarized the work against this pest and were able to present records showing 98.55 to 98.81% of worm-free fruit as a result of one spraying, while check trees yielded 72.73% of sound apples. The same care was exercised in selecting the trees in 1910 as the preceding year (see Journal Economic Entomology, 2:172-73) and in the case of series 1 the experimental trees were in the same orchard, though it was necessary to spray Northern Spy trees instead of Baldwins. Series 2 was limited to Baldwins, while small Wealthy and Mackintosh trees were used in series 3. Practically without exception arsenate of lead (15% arsenic oxide) was used at the rate of about 6 lbs. to 150 gallons of spray. One gallon of a concentrated lime-sulfur wash (about 30° Beaumé) was used as a fungicide in series 1, while in series 2 the normal Bordeaux mixture was employed for this purpose. Plot 1 in both series 1 and 2 was sprayed once just after the blossoms fell, while plot 2 in each of these series received an additional application about three weeks later, namely in early June. Plot 3 in series 2 was sprayed only once and that in early June at the time of the second spraying in plot 2. The treatment of the trees in series 3 was practically identical with the spraying described above for plot 1 in series 1 and 2.

The season of 1910 was remarkable for the development of a large second brood and consequent prevalence of wormy apples. In some unsprayed orchards over 50% of the fruit was thus affected. May

SUMMARY OF PLOTS

Series	Plot	Total	Clean Fruit Total	Clean Fruit Per cent	Wormy Fruit Total	Wormy Fruit Per cent	End Wormy	End and Side Wormy	Side Wormy	Exit Hole 1	Exit Hole 2
1	1	1,839	1,664	90.48	175	9.52	16	21	138	83	3
	2	2,846	2,756	96.84	90	3.16	6	1	83	33	0
2	1	8,135	6,677	82.08	1,458	17.92	160	27	1,271	485	3
	2	7,316	6,105	83.45	1,211	16.55	127	10	1,074	581	5
	3	7,594	4,355	57.35	3,239	42.65	1,485	326	1,428	882	33
3	Wealthy	529	371	70.14	158	29.86	12	0	146	23	..
	Mackintosh	444	219	49.[illegible]	225	50.67	25	4	196	44	..
1	Checks	711	202	28.41	509	71.59	186	240	82	298	40
2	Checks	2,000	593	29.65	1,407	70.35	700	324	383	372	20
3	Wealthy Checks	88	38	43.19	50	56.81	20	13	19	2	..
3	Mackintosh Checks	390	130	33.34	260	66.66	84	38	138	53	4

30 there was a hail storm (which did not affect series 1 and 2) and an examination showed that from 50 to 60% of the wormy fruit had been entered at points injured by the hail.

The above tabulation gives a summary which at first sight, at least, compares very unfavorably with the figures obtained in 1909. It will be seen at once that the percentage of clean fruit on sprayed trees varies from 96.84 down to 57.35 or even to 49.33, while the percentages of sound fruit on the check trees in the various plots range from 43.19 to 28.41. These last figures show at once that the codling moth was much more abundant in the Hudson valley the past season than in 1909.

Plots 1 and 2 in series 1 and 2 are respectively nearly comparable, since it will be seen by reference to the table that the percentage of infested fruit on the check trees was nearly the same. Nevertheless, there is a marked decrease in the percentage of sound fruit obtained in series 2, plot 1 yielding over 8% less than plot 1 in series 1, while plot 2 produced some 13% less of sound fruit, this in spite of the fact that the trees in series 2 bore a much larger crop and should normally produce a relatively larger percentage of sound fruit (see Journal Economic Entomology, 3:175). This discrepancy may be explainable in part by the fact that the orchard in series 1 was younger and somewhat cleaner than that in series 2, though it would seem as if a portion of this difference must be attributed to less efficient spraying in series 2, especially as experience has shown that apparently minor inattention to the application may result in a material reduction in the amount of sound fruit. Furthermore, the trees in the orchard of series 2 were somewhat closer together. There was a moderately steep hillside making thorough work somewhat difficult near the experimental trees. The majority of the other trees in the orchard were sprayed but once with Paris green and Bordeaux mixture. This application would, in our judgment, hardly be as effective in controlling the second brood of codling moth as the more adhesive arsenate of lead.

A study of the individual trees yields some data of interest. In series 1, plot 1, the number of apples per tree varied from 114 to 627. The percentage of sound fruit ranged from 85.38 to 92.98, while the number of wormy apples produced per tree was 9 to 44 or an average of a little over 29 per tree. It is worthy of note that 8.6% of the total fruit in this plot was side wormy, 7.5% being side wormy only. In plot 2 the number of apples per tree varied from 229 to 980, the percentage of sound fruit ranging from 93.93 to 97.81 and the number of wormy apples from 5 to 28, an average of only 15 per tree. There was only a little over 3.3% of the apples in this plot that were either

side and end and side wormy, or, in other words, there was a reduction in the number of side or end and side wormy of nearly 6.3%, from that in plot 1, resulting in the almost total elimination of end wormy fruit.

Comparisons with similar plots in series 2 show that the yield per tree in plot 1 ranged from 884 to 1,928, the percentage of sound fruit varying from 77.96 to 85.52, while the number of wormy apples ran from 163 to 365, or an average of 243 wormy apples per tree. Fifteen and nine-tenths per cent of the total were side wormy or end and side wormy, the latter being practically a negligible quantity. In plot 2 the yield per tree was from 134 to 2,258. The percentage of sound fruit ranged from 79.09 to 86.94, while the number of wormy apples varied from 28 to 302, or an average of nearly 202 per tree. Fourteen and eight-tenths per cent were side wormy or end and side wormy. It will be seen at once that these two series present a marked contrast to each other.

The data obtained from plot 3 of series 2 are of interest largely because they give a definite basis for estimating the value of delayed spraying or one spraying given at the time the codling moth larvæ are entering the apples, namely about three weeks after the dropping of the blossoms. The number of apples per tree in this plot varied from 315 to 1,708. The percentage of sound fruit ranged from 36.19 to 78.39, while the number of wormy fruit per tree ran from 201 to 811, an average of nearly 540 per tree, or practically twice as many as were found on either plots 1 or 2. Taking the check trees as a standard, this one application reduced the wormy apples by 27.70%, which should be compared with the reduction made by one early application, namely 52.43%. Using either the actual number of wormy apples or the percentage, it will be seen that this late spraying was only about one half as effective as one earlier.

The results in series 3 emphasize the difficulty of securing even a moderate percentage of sound fruit when there is a very small crop. Furthermore, we find a markedly higher percentage of wormy apples on the Mackintosh trees, though the Wealthy were interspersed.

We alluded earlier to the very satisfactory percentages of sound fruit obtained last year, yet the individual trees on two plots sprayed but once produced from 41 to 111 and 36 to 80 wormy fruit respectively, an average for each of 60 and 50, whereas plots 1 and 2 in series 1 of 1910, while producing a markedly smaller percentage of sound fruit, bore from 9 to 44 and 5 to 28 wormy apples, an average for these plots respectively, of 29 and 15 per tree. Percentage comparisons, while in the main accurate, by no means tell the whole story. For example, in plot 1, series 1, one tree produced 9 wormy fruit,

nearly 8% of the total yield of 114, while two other trees yielded 44 wormy apples which comprised 9.93 and 7.02% of their total product. Here we have an instance of one tree producing one fifth as many wormy apples yet bearing a higher percentage of wormy fruit, while two others in this plot, each with 44 wormy apples, gave a percentage variation of 2.91. Again, in plot 2 of series 2 the maximum number of wormy apples, namely 295 amounted to but 13.06% of the total yield of the tree, while the smallest number of wormy apples, namely 28, constituted 20.91% of the product of another. In other words, the tree with 10 times as many wormy apples produced a markedly smaller percentage of wormy fruit. Likewise, the very low percentages of sound fruit obtained in series 3 is due not so much to the large number of wormy apples as to the small crop. The Wealthy trees, for example, had but 5 to 48 wormy apples, an average of only a little over 26 per tree, while in the case of the Mackintosh the wormy fruit ranged from 8 to 69, an average of a little over 37 per tree. Comparing these figures with the wormy fruit produced by the two plots sprayed but once in 1909, we shall see that there were only half as many wormy apples, yet the percentages of sound fruit for these two plots are extremely low. We call attention to this matter simply to emphasize the fact that percentage comparisons alone are not always fair. The actual number of wormy apples on the trees in series 1 and series 3 are less than those obtained in 1909, and while we wish the percentages were better, we feel that the discrepancy between the results obtained in the two seasons is not so wide as would at first appear.

NOTE ON THE OVIPOSITION OF THE TARNISHED PLANT-BUG

By F. H. Chittenden and H. O. Marsh

In 1884 Dr. S. A. Forbes wrote an exhaustive account of the tarnished plant-bug, four stages of the nymphs being recognized, described in detail, and figured, but at that time nothing was published in regard to the egg or the method of its deposition. The following year this account was supplemented by a description of the egg, drawn from a specimen found on the petiole of a dead strawberry leaf and loosely placed among the hairs. Identification was made by comparison with others obtained from the female by dissection. In Woodworth's article, which appeared in 1889, the egg is also described

and figured in outline. Of this he wrote: "We have spent considerable time in fruitless search this spring. We have repeatedly dissected them from the adult insect and represent one so obtained in figure 1." Evidently only Forbes and Woodworth have hitherto written of the eggs, and neither described the method of oviposition. The extreme difficulty of keeping the insect alive in confinement makes it no easy task. These remarks aptly sum up the difficulties of investigating the life history of so small and active an insect.

The egg was first found April 19, having been deposited by a female on kale, and slightly inserted on the upperside of the leaf. The same day several adults of both sexes were found among the leaves of mullein, which is obviously a favorite spring food plant, since their abundance on this weed has also been recorded by Forbes. From one to half a dozen bugs were found on every plant examined, resting among the leaves. None appeared to be feeding or mating while under observation. In confinement they fed on kale and mullein, but it was not until April 26 that eggs were again obtained, nine in all.

May 23 the insects were observed in the field on mullein and volunteer turnip (*Brassica campestris*), and eggs were found in the seed-stalks, stems, and leaves of the latter, scattered about singly and in irregular rows or groups, sometimes three being placed close together.

The eggs, as was surmised by Woodworth, are inserted by means of the ovipositor and thrust straight into the stems toward the center. When deposited on leaves they are usually inserted in the midribs, but occasionally also on the edges of the leaves. Many have been observed deposited in this way in confinement. Evidently in nature they are deposited chiefly in the stems, less seldom in the midribs, and only occasionally in the leaves. When deposited in the stems the eggs are inserted until flush with the surface, while those deposited in leaves are usually thrust only partially into the tissue of the leaf.

In case of oviposition on mullein, which is the favorite plant for the purpose in the District of Columbia, the eggs are inserted in the petiole or leaf-stem and in the midrib. They are frequently placed very closely together and in confinement as many as nine were counted on a single leaf an inch long and half as wide.

A comparison of the stages figured and described by Forbes with material obtained at Washington leads to the conclusion that the second stage was missed; indeed, it is probably this stage that has been more often overlooked than any other by those who have written of the life stages of the Heteroptera. In Woodworth's account the first and second stages are correctly figured, and his third stage is in reality the fourth. In Stedman's article, what he terms a second stage is either the third or fourth, while his fourth stage represents

the fifth. Only four stages of growth between the egg and the mature form have hitherto been recognized. Dr. L. O. Howard stated in 1901,[a] "The natural egg place of this common insect is not known, but the rest of its life has been well worked out by Woodworth, although there is probably one more molt than he has observed, *i. e.*, five instead of four." The senior writer has also said of this species, "There is little doubt that there are five stages, to agree with other species of plant-bugs which have been traced through their metamorphoses," this deduction having been drawn from his experience in rearing Anasa and Leptoglossus and that of Quaintance and Slingerland, who have observed five nymphal stages of *Pamera vincta* Say and *Pœcilocapsus lineatus* Fab., respectively.

THE EFFECT OF MOISTURE AND DRYNESS ON THE EMERGENCE FROM THE EGG OF THE WALKING-STICK, *DIAPHEROMERA FEMORATA* SAY

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Heymons[1], Godelmann[2] and Stokard[3] have all noticed that in various species of Phasmidæ some specimens, after issuing from the egg, may have one or more legs caught within the egg-shell and drag it after them for hours. Besides confirming these observations we frequently noticed that one or both antennæ or even the abdomen together with one or more legs may fail to be withdrawn from the egg-capsule. Some specimens, after having withdrawn the prothorax, part of the head and mesothorax, were unable to extricate themselves further.

A number of experiments were performed in order to determine why the walking-sticks fail to emerge completely from the egg-shell. One thousand eggs were kept on wet sand in a breeding cage; another thousand were put in a tin box and kept perfectly dry from the time they were deposited in the autumn. The following table shows the results of hatchings of two hundred eggs kept in dry and moist surroundings.

The table shows that 13% of the 200 specimens hatched under wet conditions, and 94% of the 200 specimens hatched under dry con-

[a]The Insect Book, New York, 1901, p. 301.

TABLE 1

	Wet conditions	Dry conditions
Number of eggs hatched	200	200
Specimens which emerged completely from the egg-shell	174	12
Specimens unable to emerge completely from the egg-shell	26	188

ditions failed, after springing off the operculum, to extract themselves completely from the egg-shell. It is evident from this that dryness has a marked effect upon the complete emergence of the walking-stick from the egg.

In the next experiment, some of those specimens, which failed to free themselves fully from the egg, were put into a glass jar containing about an inch of wet sand covered with moistened filter paper. Those walking-sticks, which had one or more legs caught within the egg-shell, usually succeeded in withdrawing all the appendages, while those that had all the legs, antennæ and abdomen caught, ordinarily failed to free themselves.

In another experiment, some of the walking-sticks, which failed to extricate themselves completely from the egg, were put into a glass jar under dry conditions. These specimens, without exception, failed to withdraw the parts caught within the egg-capsule and all died with the same parts still held securely within the egg.

Godelmann[1] observed in *Bacillus rossi*——? that "die jungen Larven die Eihülsen auf die Dornen der Brombeerranken zu stulpen versuchten und dann mit den Vorderfüszen klimmzuartige Bewegungen ausführten, um sich zu befreien, wobei nicht selten ein Bein oder mehrere verloren gingen, die dann später nach der Häutung regenerirt wurden." In only a few cases, have we observed a walking-stick throw off a leg which was caught within the shell-egg. When a specimen, which had one or more legs caught, was put in a glass jar containing a twig from a hazel-nut shrub, the leaves furnished enough moisture by transpiration to allow nearly all of the young walking-sticks to withdraw the appendages.

The eggs, which still remained unhatched, were now interchanged, the remaining 800 eggs, which had been on the wet sand being transferred to the dry conditions and *vice versa*. The following table shows the results of the hatching of the next 100 eggs in each case:

TABLE 2

	Transferred from wet to dry conditions	Transferred from dry to wet conditions
Number of eggs hatched..............	100	100
Specimens which had emerged completely from the egg-shell..................	8	80
Specimens unable to emerge completely from the egg-shell..................	92	20

The table shows that 92% of the 100 specimens which hatched from the eggs that were kept formerly under wet conditions and then transferred to dry, and 20% of the 100 specimens which hatched from the eggs that were formerly kept under dry conditions, and then transferred to wet, failed, after pushing off the operculum, to extricate themselves completely from the egg-capsule. It is evident from these experiments that dryness at the time of hatching has a marked effect upon the emergence of the walking-stick from the egg.

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[2] **Heymons, R.,** 1897. Uber die Organisation und Entwickelung von Bacillus rossii Fabr. Sitzb. d. Kgl. Akad. d. Wiss. Berlin XVI, pp. 363–374.

[3] **Stockard, C. R,** 1908. Habits, Reactions and Mating Instincts of the Walking-stick, Aplopus mayeri. Publ. No. 103 Carnegie Inst., Washington, pp. 43–59.

Coccidae of Boulder County, Colorado.—Mr. D. B. Thurston has recently brought me two species new to the list, collected in Boulder this fall. These are *Aulacaspis rosæ* (Bouché), on cultivated *Rubus*, and *Pulvinaria innumerabilis* (Rathv.) on maple. The *Pulvinaria* has been known here for some years, but by some oversight I failed to obtain specimens before. From the *Pulvinaria bigeloviæ* on *Chrysothamnus*, already recorded, I bred a parasite, which has now been identified by Doctor Howard as *Coccophagus immaculatus* Howard. In his Revision of the Aphelininæ Howard reports *C. immaculatus* only from *Eriococcus azaleæ*, in the District of Columbia. It is rather surprising to find it now in the arid west, infesting a coccid of a quite different group.

T. D. A. COCKERELL.

A LIST OF THE APHIDIDÆ OF ILLINOIS, WITH NOTES ON SOME OF THE SPECIES

By JOHN J. DAVIS, *Office of the State Entomologist, Urbana, Illinois.*

(*Continued from p. 419*)

In the first part of this paper (Jour. Econ. Ent., Vol. III, Oct., 1910, p. 410) *Pemphigus corrugatans* Sirrine was questionably listed from Illinois. I have since had an opportunity, through the courtesy of Mr. J. T. Monell, to examine cotypes of *P. corrugatans* in Monell's collection and find that my Le Roy specimens are not that species. Plate 31, figures 1 and 2 are camera lucida drawings of the wing and antenna from the cotypes mentioned above. The label on the slide examined is as follows,—"454[xa] cotypes *Pemphigus corrugatans.* Winged adults, pupa, and larvæ of II? From curled colored leaves of *Cratægus coccinea* var. I. A. C. 6-26-93. In balsam. F. A. S." Plate 31, figures 3 and 4 were drawn from winged viviparous females of a *Pemphigus* corrugating the leaves of *Cratægus* sp. at LeRoy, Ill., July 7, 1907. This latter may be Fitch's *P. pyri.*

[d]*Aphis apocyni* Koch: Thomas 8th Rept. St. Ent. Ill. (1880), p. 94. The *Apocynum* aphis characterized by Thomas is probably not Koch's *apocyni* and it is still to be proven that the European species occurs in America. First reported by Thomas.

**A. asclepiadis* Fitch: Oestlund, Bull. Geol., and Nat. Hist. Surv. Minn. No. 4 (1887), p. 60. A very common species on *Asclepias.*

A. atriplicis Linn.: Hayhurst, Annals Ent. Soc. Amer., Vol. II (1909), p. 88, figs. Common on *Chenopodium album* throughout the state, especially common in southern Illinois. First reported by Monell.

• *A. avenæ* Fab.: Pergande, Bull. Div. Ent., U. S. D. A., No. 44 (1904), p. 5, figs. A common wheat aphis but rarely destructively abundant. First reported by Forbes.

A. bakeri Cowen: Gillette, Jour. Econ. Ent., Vol. I (1908), p. 364, figs.; Davis, Annals Ent. Soc. Amer., Vol. I (1908), p. 259, figs. A common species throughout the state on red clover. First reported by the writer.

A. brassicæ Linn.: Weed, Insect Life, Vol. III (1890), p. 289, 1 fig.; Sanborn, Kans. Uni. Sci. Bull., Vol. III (1904), p. 54, 1 fig. Our most generally destructive aphis of the vegetable gardens, and a most difficultly controlled one in the commercial gardens, the expenses of fighting the aphis soon using up the small profit which is to be made. First reported by Thomas(?).

**A. brevis* Sand.: 13th Ann. Rept. Del. Agr. Expt. Sta. 1901 (1902),

p. 157, 2 figs. Common in Central Illinois on the red haw (*Cratægus coccinea*.)

†*A. carduella* Walsh: Oestlund, Bull. Geol. and Nat. Hist. Surv. Minn., No. 4 (1887), p. 59. First reported by Walsh. I am unacquainted with this species.

**A. cardui* Linn.: Oestlund, Bull., Geol. and Nat. Hist. Surv. Minn., No. 4 (1887), p. 65. A very common species on the purple thistle, invariably attended by ants (*Formica* sp.).

†*A. cephalanthi* Thos.: Davis, Annals Ent. Soc. Amer., Vol. II (1909), p. 40, figs. Not uncommonly injuriously abundant on the button-bush shrub (*Cephalanthus occidentalis*), which is often used in ornamental plantings. It usually becomes most abundant in the fall of the year. First reported by Thomas.

**A. cerasifoliæ* Fitch: Oestlund, Bull. Geol. and Nat. Hist. Surv. Minn., No. 4 (1887), p. 51. A serious pest of *Prunus pennsylvanicus*, a shrub commonly planted in parks, and living on the undersides of the leaves, curling them badly, and thus seriously disfiguring the natural beauty. I have found them so abundant as to disfigure every leaf on a clump of these shrubs and to cause the leaves to turn brown and often fall off in midsummer.

**A. coreopsidis* Thos.: 8th Rept. St. Ent. Ill. (1880), p. 59, figs.; Oestlund, 14th Rept. Geol. and Nat. Hist. Surv. Minn. (1886), p. 38, (*A. frondosæ*). Last fall (1909) this species became very abundant at Oak Park, Ill., infesting the stem, leaves, flowers, and flower stalks, principally the two latter, of *Bidens vulgata*, and this fall (October 3, 1910) I found it rather common on *Bidens bipinnata* at Anna, Illinois. Infested plants in confinement were continually watched until the plants and aphids were killed by the cold, with no sign of an oviparous generation. Noticing the marked resemblance between the descriptions of *Siphonophora coreopsidis* Thos. and *A. frondosæ* Oestl., I wrote Professor Oestlund who kindly sent me a mounted specimen of his species. I have thus been able to positively identify my Oak Park specimens as the species described as *A frondosæ*. Mr. Monell has sent me specimens from *Coreopsis* collected in St. Louis, which he determined as *A. coreopsidis* and also a copy of the original type color notes. From all these sources I have studied and compared my species and conclude that the two species, *A. frondosæ* and *A. coreopsidis*, are synonymous. In all specimens the color notes and habits agree quite well. Mr. Monell's specimens were smaller but the relative antennal measurements agree with my specimens excepting in some specimens the length of filament VI is longer, but this appears to be quite variable and can hardly be considered of specific value. Camera lucida drawings, of

the antenna, cornicle and style of the winged viviparous female are given in Plate 32, figures 11, 12, and 13, respectively.

I herewith give antennal measurements which I have made:[d]

Data on slide	Sensoria			Antennal lengths in mm.						
	III	IV	V	I	II	III	IV	V	VI base	VI filament
Aphis frondosæ	11	8	4	0.0652	0.0570	0.3749	0.2282	0.2200	0.1141	0.4727
8–30–'03 O. W. Oestlund Coll.	11	7	3	0.0652	0.0570	0.3830	0.2526	0.2282	0.1059	0.4645
Oak Park, Ill.	12	6	4	0.0733	0.0570	0.3423	0.2282	0.2282	......	......
On Bidens vulgatus 27th Sept. '09, Davis	12	7	4	0.0733	0.0570	0.3586	0.2282	0.2119	......	......
Oak Park, Ill.	11	8	2	0.0652	0.0489	0.3423	0.2282	0.2119	0.1141	0.4564
On Bidens vulgatus 27th Sept. '09, Davis	11	7	3	......	......	0.3586	0.2445	0.2119	0.1059	0.4482
Oak Park, Ill.	...	...	...	......	......	0.3749	0.2363	0.2119	0.0978	0.4401
On Bidens vulgatus 27th Sept. '09, Davis	...	...	...	......	......	0.3586	0.2200	0.2282	0.0896	0.4401
Oak Park, Ill.	11	8	4	......	......	0.3749	0.2852	0.2445	0.1059	......
On Bidens vulgatus 8th Oct. '09, Davis	12	8	4	......	......	0.3586	0.2934	0.2526	0.1141	0.4238
684x, St. Louis, Mo.	13	6	5	0.0570	0.0489	0.2771	0.1793	0.1793	0.0733	0.4645
On Coreopsis 25th July '08. J. T. Monell coll.	15	7	3	0.0570	0.0489	0.3015	0.1793	0.1711	0.0896	0.4492
684x, St. Louis, Mo.	14	6	4	......	......	0.2771	0.1874	0.1793	0.0815	......
On Coreopsis 25th July '08, J. T. Monell coll.	...	...	...	......	......	0.2852	0.1956	0.1793	0.0815	0.4645
684x, St. Louis, Mo.	...	...	...	......	......	......	0.1956	0.1793	0.0815	0.3993
On Coroepsis 25th July '08. J. T. Monell coll.	...	...	...	......	......	......	......	......	......	......

[d]*A. cornifoliæ* Fitch: Cat. Hom. N. Y., 1851, p. 65; Oestlund, Bull. Geol. and Nat. Hist. Surv., Minn., No. 4 (1887), p. 53. This species has often been confused with the more common *Aphis* on *Cornus*, *A. helianthi*. In his original description of *cornifoliæ* Fitch says, "Apterous females black," and Oestlund describes the color of the abdomen of the winged viviparous female as "dark brown." I have received from Mr. Monell a note on this species, an abstract of long color notes made by Mr. Th. Pergande. I copy in full as received from Mr. Monell.

"315x On Cornus lvs. Maryland, May 26–27, '85 (Abstract of long color notes). *Winged:* — Hd. and thorax, nectaries and tail black. Abdomen dark brownish, almost blk. Wings pale dusky. *Apterous.* Dull blk., the abdomen somewhat brownish. *Pupa.* Hd. and thorax dark greenish covered with fine mealy grayish excretion. Abdomen greenish brown with grayish excretion, often two pale distinct stripes of excretion on dorsum. Wing pads dull yellowish.

"This is all *essentials* of color notes verbatim — from Th. Pergande. J. T. Monell."

Mr. Monell very kindly mounted some of the remains (from alcohol) of the specimens from which these notes were made, but they are so shrunken as to be of little value in working out the characters.

The species recently referred to by Professor Gillette as *Aphis cornifoliæ* (Jour. Econ. Ent., Vol. III, Oct. 1910, p. 405) is not, in my opinion the true *cornifoliæ*, but rather the *helianthi* of Monell. This species has never been positively reported from Illinois, all records of the occurrence of *cornifoliæ* in this state apparently referring to the migrant form of *helianthi*.

**A. cratægifoliæ* Fitch: Sanborn, Kans. Uni. Sci. Bull. Vol. III, No. 1 (1904), p. 53, 1 fig. A common species on *Cratægus* in the Chicago parks. It curls the leaves and is often injuriously abundant.

ᵗ*A. folsomii* Davis: Ent. News, Vol. XIX (1908), p. 143, 1 pl. Common at Urbana and Chicago attacking Virginia creeper. First reported by the writer.

A. forbesi Weed: Sanderson, 12th Ann. Rept. Del. Agr. Exper. Sta. f., 1900 (1901), p. 143, 6 figs., 1 pl. Common throughout the state, sometimes a serious pest. First reported by Forbes.

A. gossypii Glov.: Pergande, Insect Life, Vol. 7 (1895), p. 309. One of our most common and destructive aphids. In the western part of the state in the melon fields, they do much damage annually. In greenhouses they are often very injuriously abundant on cucumbers as well as on althæa, Hibiscus and Easter lily, especially in more or less neglected houses. First reported by Forbes (as *cucumeris*).

**A. houghtonensis* Troop: Ent. News, Vol. XVII (1906), p. 59, 3 figs. This species was found very common, curling the leaves of gooseberry shrubs growing wild at Aurora, Ill., June 17 and 22, 1910. The drawings by Mr. Heidemann in the article cited above represent the general characters of the species exceedingly well. The antenna of the winged viviparous female, showing the number and position of the sensoria, is illustrated in Pl. 31, fig. 5.

A. helianthi Monl.: Bull. U. S. Geol. and Geog. Surv., Vol. V (1879), p. 26; Weed, Psyche, Vol. V (1888), p. 123. This aphis is very common on various species of *Helianthus*, especially *H. grosseserratus*, *H. divaricatus*, and *H. annuus*. The green aphis so common on *Cornus* leaves in spring and fall is apparently the same species, and not the *A. cornifoliæ* of Fitch as has been so commonly supposed. See discussion above under *cornifoliæ*. Mr. Monell, who has spent much time studying *helianthi*, both on *Helianthus* and on *Cornus*, is also of the opinion that the green *Aphis* on Cornus is the spring and fall form of *A. helianthi*. First reported by Weed (as *cornifoliæ*).

ᵗ*A. illinoisensis* Shimer: Prairie Farmer, Vol. 18, No. 20, Nov. 17, 1866, p. 316. Although not positively proven, it is my opinion

that this species is identical with that described in 1880 by Doctor Thomas as *Macrosiphum* (*Siphonophora*) *viticola*. Shimer's description agrees in every respect with the well known *viticola*, excepting the statement about the "tubercles" (-cornicles?) and in this Shimer has contradicted himself, for while in the description he says "tubercles about one half the length of the tarsi," later in a discussion he speaks of the "horny tubes," in dried specimens, being about twice the length of the tarsi. Inasmuch as the original description of this species is inaccessible to nearly every worker, I consider it of importance to quote verbatim the description as given in the *Prairie Farmer*.

"A NEW GRAPE APHIS

"BY HENRY SHIMER, M. D.

"*Larva* brown, anteriorly darkest. Green at first.

"*Pupa* brown. Rudimental wing and collar slightly tinged with green.

"*Imago* black. Thorax deep black. Abdomen brownish, transversely rugous, beneath, *i. e.*, segments beneath conspicuous; tubercles about one half the length of the tarsi, cylindrical, around the base of which, somewhat distant, the latter margins of the posterior abdomen are conspicuously elevated. Legs black. Anterior femur above lower part of the anterior and middle tibia, premuscus and base of wing nervures grey. Antennæ black. Setiform attaining the basal fifth of the stigma of the expanding wings. The first joint prominent, thick, sub-cylindrical, bevel margined on the upper end. Second shortest, not half the diameter of the first, but decidedly thicker than the following which gradually tapers to the pointed end. Third joint very long, longest, obclavate, the next three gradually shortening successively, the terminal abruptly smaller, setiform almost as long as the third. Eyes black, globular, prominent. Tibia; hairy, somewhat curved. First tarsal joint thick, not easily distinguishable from the tibia; second curved downward long and much tapering from the unguis toward the articulation. Wings hyaline, producing prismatic colors in the sunshine. Anterior wing long, the base acute angled from the middle. Exterior end rounded, in life erect, folded together, perpendicularly over the back, the posterior margin above. Nervures black. The terminal third of the narrow costal and sub-costal space filled with an opaque buff brown narrow elongate, falcate spot. Punctum marginal, about six times as long as wide, black on the posterior border, acute, obliquely pointed at each end tapering internally into the cubitus, and externally into the costal border, from the base of the terminal fifth. From the obtuse angle thus formed at the base of the terminal fifth springs the much curved intercalor stigmatic vein, being curved in the first part of its course — a true parabola with the principal vertex in the carpus, the third discoidal, the three branching vein arises from the internal point of the opaque space, second and first simple, the latter terminating in a tumeaction of the posterior marginal, a narrow elongate conspicuous vittla mostly internally from its extreme origin; a few long, very much attenuated, tapering acute capillary hairs arise from the third discoidal, below the first branch.

"Posterior wing small more pointed, obliquely incised on the anterior margin at the outer end, the sub-marginal vein also deflected parallel and very close to the incised border, decidedly closer than at the middle of the wing and terminating at the apex. Length to tip of wings, .14 inch, of body, .05, anterior wings, .10, antennæ, .05."

Following this description Doctor Shimer gives notes on the habits, which agree with those of *M. viticola*, and the predaceous and parasitic insects of his species. He also discusses at some length on the differences between this and the European *A. vitis* Scop. At the end he adds a note, as follows.

"Note — Since writing the above I have seen this insect on wild grape and Mr. Walsh has informed me that he has examined carefully, some dried specimens

I sent him and that they were perfectly identical with the insect he saw, when he published for it Scopolis Cypeosis. With doubt he referred it to Aphis vittis Scopoli, P. Ent. Soc. vol. 1. There is no specific identity between this and the foreign insects as appears from the above description made from a thorough examination of hundreds of living insects, and as it is found in various parts of the state I would propose for it the specific name, illinoisensis."

†*A. impatientis* Thos.: 8th Rept. State Ent. Ill. (1880), p. 98. First reported by Thomas and not since reported in literature except in catalogues. I am unacquainted with the species.

**A. loniceræ* Monl.: Bull. U. S. Geol. and Geog. Surv., Vol. V, No. 1 (1879), p. 26; Oestlund, Bull. Geol. and Nat. Hist. Surv., Minn., No. 4 (1887), p. 55. This interesting and peculiar aphid I have taken but once, namely at Oak Park, Ill., July 16, 1910, on *Lonicera* sp. At this time only wingless were found, and they were extremely abundant on the tender terminal shoots and leaves, more commonly on the former. The newer leaves have the sides curled upwards forming a pseudogall within which the aphids were also found. The colonies and individual aphids are covered with a heavy pulverulence. When the *Lonicera* shrub was examined a second time (23 Aug., 1910), only three immature individuals were found. The species is neither a typical *Aphis* nor *Chaitophorus* (in which latter genus Thomas placed it), but it unquestionably fits better in the former genus. Camera lucida drawings of the antennæ, hind tibia and tarsus cornicle, style and head of the wingless viviparous female are given in Plates 31–32, figures 6, 7, 8, 9 and 10, respectively.

†[1]*A. lutescens* Monl.: Bull. U. S. Geol. and Geog. Surv., Vol. V (1879), p. 23. I have taken this species twice in the vicinity of Chicago, on *Asclepias*. First reported by Monell.

A. maidis Fitch: Davis, Tech. Bull. Bur. Ent., U. S. D. A., No. 12, pt. VIII (1909), p. 144. Common on various weeds and grasses as well as on corn, broom corn, and sorghum, throughout the state. On the three cultivated plants mentioned it is often injurious, particularly so on broom corn where it discolors the broom, thus damaging the quality of brush. First reported by Thomas.

†*A. maidi-radicis* Forbes: 18th Rept. St. Ent. Ill. (1894), p. 58, figs.; Davis *loc. cit.* p. 123. One of the most destructive corn pests in Illinois; also of prime importance as an aster insect, having been found killing thousands of plants in single fields of asters in the vicinity of Chicago. First reported by Walsh.

**A. medicaginis* Koch: Thomas, 8th Rept. St. Ent. Ill. (1880), p. 101. This has proven a very important enemy of the black locust, which is grown extensively in the Chicago parks as shrubbery. The lice cluster on the tender terminal shoots and may become so abun-

[1] Illinois one of the type localities.

dant as to blacken them, not only stunting the growth, but often completely killing these tender branches.

[t1]*A. middletoni* Thos.: 8th Rept. St. Ent. Ill. (1880), p. 99; Vickery, Bull. U. S. Dept. Agr., Bur. Ent. No. 85, Pt. VI (1910), p. 113. I have never taken this species. First reported by Thomas (?).

**A. neilliæ* Oest.: Bull. Geol. and Nat. Hist. Surv. Minn., No. 4 (1887), p. 59. This species has not, I believe, been reported since the original description, Professor Oestlund having found it in Minnesota on *Neillia opulifolia*, the common pine bark, now known as *Physocarpus* (*Spiræa*) *opulifolius*, a shrub much used in ornamental plantings. Last year (1909) at Oak Park, Ill., it became so abundant that the leaves were badly curled and the shoots stunted or even killed. The winged viviparous female is well characterized by the very tuberculate antennæ, brown wing veins, conspicuous black stigma and dark brown to blackish body color. The sexes were first observed October 9, and from the numbers of eggs already deposited they had been there for several weeks. At this time the leaves and shoots were covered with the aphids and dozens of pairs were observed *in copula*. The sexes are interesting in that the male is wingless as is also the oviparous female. These males are very small, brownish red to black and the ocelli absent. The oviparous females are entirely black. Eggs are laid by the hundreds in the crevices formed by the leaf petiole and stem, and by the dormant buds. This spring (1910) the eggs commenced hatching March 30, a few days after the leaves appeared.

[d]*A. nerii* Fonsc.: Thomas, 8th Rept. St. Ent. Ill. (1880), p. 95. It is probable that Thomas found the species which he questionably referred to *nerii* in Illinois, although he does not so state. The record here is questioned.

**A. persicæ-niger* Smith, E. F.: Gillette, Jour. Econ. Ent. Vol. I (1908), p. 308, figs. and col. pl. A common pest of the peach.

A. pomi De G.: Gillette, *loc. cit.* p. 303. A common and often destructive pest of the apple in Illinois; also occasionally found injuring the tender shoots of the flowering or Japanese quince (*Cydonia japonica*) in the Chicago parks. First reported by Fitch.

**A. œnotheræ* Oestl.: Bull. Geol. and Nat. Hist. Surv. Minn., No. 4 (1887), p. 62. It is with some doubt that I record this species from Illinois. Specimens collected in Chicago on *Œnothera biennis* agree exactly with the description and habits as given by Oestlund except in the following: In addition to the marginal row of black spots the Chicago specimens have transverse dusky markings on

[1] The indications are that Thomas made his type collections in Illinois, but he does not say positively.

the three last abdominal segments. The cornicles are only two to two and a half times the length of the tarsi. The style is pale or pale greenish and not dusky or black as given in the original description.

**A. populifoliæ* Fitch: Cat. Homopt. N. Y. 1851, p. 66. This very interesting species was found infesting the tender terminal shoots and under surfaces of the leaves of the quaking aspen (*Populus tremuloides*), June 27, 1910, in one of the Chicago parks. All of the *P. tremuloides* in this park had recently been secured from their native habitat in Indiana, just across the state line and not far from Chicago. The same species was also taken on the common Carolina poplar (*P. deltoides*) in a Chicago nursery, June 30, 1910. August 23, the trees so heavily infested nearly two months before were visited, but not a single aphis could be found. Through the kindness of Mr. J. T. Monell I have had the privilege of examining specimens in his collections of this same species and which he has long considered to be the *populifoliæ* of Fitch. These Monell specimens are labeled "293*x* Washington, D. C., Sept. 30, 1880, *Populus alba*. From Theo. Pergande."

From the brief description given by Fitch it is difficult if not impossible to identify the species with certainty, although one might be led to believe that he was dealing with a species of the genus *Melanoxantherum*. Notwithstanding the slight differences in measurements the aphid in question is possibly the one Fitch was dealing with. *Populifoliæ* Fitch has generally been considered a species of the genus *Chaitophorus* but the one here considered, although showing marked *Chaitophorus* tendencies, is nearest related to the genus *Aphis*.

The *Chait. populifoliæ* as described by Oestlund[1] is clearly not Fitch's species. Through the courtesy of Professor Oestlund, I have examined the species which he described and questionably referred to the *populifoliæ* Fitch. It is a typical *Chaitophorus* and a new species which I propose shall hereafter be known as *Chaitophorus populifoliæ* Oestlund. These two species and a new species on poplar are fully described and discussed in another paper soon to be published and it is therefore sufficient to give here simply a brief description of the species which is being considered by the writer as Fitch's *populifoliæ*.

Wingless viviparous female.— Entire body dark reddish brown with very conspicuous white flocculent patches, namely a row on each side of the abdomen and two more or less regular longitudinal rows on the dorsum, one on each side of the median line. Under surface of abdomen with a large patch of whitish pulverulence. Antennæ not reaching to the base of cornicles; segment III longest, it being about twice the length of IV, IV and V subequal, base VI about half the length of V and a third the length of the filament. Legs with femur black excepting extreme base, tibia whitish except distal ends which are black and the tarsus black. Style black and moderately long, nearly one half the length of cornicles. Cornicles black, rather long, and cylindrical.

[1] Bull. Geol. and Nat. Hist. Surv. Minn., No. 4 (1887), p. 38.

Winged viviparous female.— Head and thorax black. Abdomen dark reddish brown with the posterior end darkening to blackish. Abdomen with a row of three small but conspicuous white pulverulent spots on each side of the median and anterior to the cornicles; also many other white pulverulent dots on the abdomen, but they are rather inconspicuous and easily rubbed off. Antennæ black; not reaching the base of the cornicles; relative lengths of antennal segments as in wingless; segment III with about 14 circular sensoria, more or less in a row, and the usual ones at distal ends of V and base VI. Legs with the femur blackish excepting basal end, tibia whitish or pale brownish with the distal one third or one half blackish, tarsus black. Wing veins dark, stigma blackish. Style black. Cornicles black, cylindrical, and reaching to the base of the style.

**A. prunifoliæ* Fitch: 1st Report Insects N. Y. (1855), p. 122. I have taken this species but once, namely on plum at Niles Center, Ill., June 18, 1908.

**A. sorbi* Kalt.: Sanderson, 13th Rep. Del. Agr. Exp. Sta., 1901 (1902), p. 149, 4 figs. A rather uncommon species, which I have taken only in northern Illinois.

†*A. quercifoliæ* Walsh: Proc. Ent. Soc. Phil. Vol. I (1862), p. 298. I am unacquainted with this species. First reported by Walsh.

A. rufomaculata Wils.: Ent. News, Vol. XIX (1908), p. 261. A serious pest of the greenhouse chrysanthemum. First reported by the writer.

**A. sambucifoliæ* Fitch: Sanborn, Kans. Univ. Sci. Bull. Vol. III, No. 1 (1904), p. 52, 2 figs. A very common species attacking the ornamental elder in the Chicago parks, but is not a serious pest. The sexual forms, the small winged males, and the wingless oviparous females, appear in September and October in northern Illinois, usually becoming mature the latter part of September.

†*A. salicicola* Thos.: 8th Rep. State Ent. Ill. (1880), p. 63 (Siphonophora). A common willow aphis in Illinois. First reported by Thomas.

†*A. setariæ* Thos.: 8th Rep. State Ent. Ill. (1880), p. 56; Oestlund Bull. Geol. and Nat. Hist. Surv. Minn. No. 4 (1887), p. 67. A very common species, occurring throughout the state. First reported by Thomas.

**A. spiræella* Schout. ?? In the JOURNAL OF ECONOMIC ENTOMOLOGY for October, 1910 (p. 404), Professor Gillette has noted this species as occurring in America. It has been very abundant and destructive on *Spiræa vanhouttei* and *S. salicifolia* in many parts of Illinois and after a careful study and comparison with the original description of *spiræella*[1] I consider it distinct but will leave it as above until specimens of the European species can be obtained (my efforts in this connection have thus far been useless) for comparison. The most noteworthy differences are in the antennal lengths which

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[1] Zoölogisches Anzeiger, Vol. 25 (1902), pp. 656–657.

in all my winged specimens are exceptionally constant and the fact that *spiræella* rolls the leaves and as Schouteden says, "Die Blattmitzbilbungen, welche *Aphis spiræa* [=*spirætella*] erzeugt, sind bereits von verschiedenen Cecidiologen beobachtet worden."[1]

The following table of comparison may be of interest:

Winged viviparous female.	
A. spiræella. Schout.	*A. spiræella* ?? from Illinois.
Under rolled leaves of *Spiræa ulmaria.*	Colonizing on the tender terminal shoots and leaves of *S. vanhouttei* and *S. salicifolia.*
Abdomen green, usually marbled.	Abdomen pale green.
Head and thorax black.	Head and thorax black.
Antennal measurements, III =longest. IV =three-fourths of III. V =one-half of III. (VI) =one-half of (VII). (VII) =about three-fourths of III.	Antennal measurements, III =four-fifths of (VII). IV =three-fourths of III. V =three-fourths of III. (VI) =one-third of (VII). (VII) =longest.
Beak reaching to hind legs.	Beak reaching to second pair of legs.
Style half the length of cornicles, dark green.	Style more than half the length of cornicles, black.
Cornicles black, paler at tip.	Cornicles black.
Wings transparent, wing veins (Wurzel und Unterrandader) greenish, cubitus twice or only once branched.	Wings transparent, wing veins pale brownish, cubitus twice branched.
Last segment of abdomen sometimes marked or striped with black.	Sometimes with dusky markings on abdomen as given, description below.
Wingless viviparous female.	
Antennæ shorter than body, blackish, third segment pale.	Antennæ shorter than body, segments I and II dusky, III and IV pale, V and VI darkening to black.
Relative antennal measurements about as in winged.	Relative antennal measurements about as in winged.
Legs greenish, tips of femora and tibiæ and the tarsi dark green.	Legs pale greenish white, excepting "knee" joint, tip of tibiæ and tarsi blackish.
Style hairy, nearly half length of cornicles, dark green.	Style moderately hairy, nearly half length of cornicles, black.
Cornicles dark green, black and somewhat thinner at tips.	Cornicles black, gradually narrowing towards the tip.

Winged viviparous female.— Head (Pl. 32, fig. 14) and thorax black, abdomen pale green, and sometimes with a row of three dusky spots on each side anterior to the cornicles, one at the base of each cornicle, and a faint dusky transverse marking on each of the last two segments. Eyes black. Antennæ pale except the two basal segments which are dusky and the distal ends of V and all of VI which are blackish (in some specimens only the basal ends of the segments are pale, the tips being dusky to blackish), not reaching the base of cornicles, filament VI longest, III four fifths of filament VI, IV and V subequal and each about three fourths of III, base VI one third of filament VI; 6 or 7 rather large circular sensoria in a row on segment III, sometimes one or two on IV, and the usual ones at the distal ends of V and base VI (Pl. 32, fig. 16). Wing veins pale brownish, first and second discoidals

[1] *Loc. cit.* p. 657

branching at one third the distance from the tip of the wing to where the third branches (Pl. 32, fig. 17). Legs pale brownish, excepting the distal ends of femora, tibiæ and all of tarsi which are blackish. Thoracic tubercle prominent. Smaller but similar tubercles along the sides of the abdomen. Cornicles black, cylindrical, and nearly one half longer than style (Pl. 32, fig. 18). Style black (Pl. 32, fig. 19).

Measurements.— (From specimens mounted in balsam.) Length of body, 1.2-1.59 mm., average, 1.39 mm.; width, 0.58–0.83 mm., avg. 0.64 mm.; length of wing, 2.1 mm.; width, 0.87 mm.; antenna, I, 0.057; II, 0.049; III, 0.179–0.260, avg. 0.216; IV, 0.131–0.195; avg. 0.160; V, 0.138–0.180, avg. 0.161; VI, base, 0.0815–0.114, avg. 0.098; VI, filament, 0.228–0.293, avg. 0.280; avg. total, 1.101 mm.; length of cornicles, 0.17–0.24 mm., avg. 0.205 mm.; style, 0.105–0.16 mm., avg. 0.14 mm.; hind tarsus, 0.10 mm.

Wingless viviparous female.— Body pale green, head dusky. Eyes black. Antennæ with segments I and II dusky, III, IV, and basal half of V pale, end of V and all of VI blackish; relative lengths of segments as in winged form.[1] (Pl. 32, fig. 15). Legs pale greenish white excepting joints, distal end of tibiæ, and all of tarsi which are blackish. Thoracic and abdominal tubercles as in winged. Cornicles black, very slightly narrowing towards the tip. Style black.

Measurements.—Length of body, 1.39 mm.; width, 0.85 mm.; antenna, I, 0.057; II, 0.049; III, 0.20–0.29, avg. 0.24; IV, 0.13–0.24, avg. 0.17; V, 0.14–0.21, avg. 0.17; VI, base, 0.098; VI, filament, 0.235–0.277, avg. 0.255; avg. total, 1.039 mm.; cornicles, 0.305 mm.; style, 0.175 mm.; hind tarsus, 0.115 mm.

The winged male may be recognized by the numerous sensoria on segments III, IV, and VI base, of the antennæ; by its smaller size; and the greenish brown abdomen.

The wingless oviparous female is pale greenish yellow to yellow and the hind tibiæ are swollen and bear many sensoria.

[d]*A. symphoricarpi* Thos.: 8th Rep. State Ent. Ill. (1880), p. 99; Oestlund, Bull; Geol. and Nat. Hist. Surv. Minn. No. 4 (1887),, p. 50. I have frequently searched for this species in Chicago and vicinity without success. There is no record of its occurrence in Illinois other than in Hunter's compiled list.

[t2]*A. vernoniæ* Thos.: 8th Rep. State Ent. Ill. (1880), p. 97; Sanborn, Kans. Univ. Sci. Bull., Vol. III, No. 1 (1904), p. 57, 2 figs. First reported by Thomas.

**A. viburnicola* Gill.: Ent. News, Vol. XX (1909), p. 280, 1 pl. Common on snowball (*Viburnum opulus*) in the vicinity of Chicago.

[t]*Cerosipha rubifolii* Thos.: Sanborn, Kans. Univ. Sci. Bull., Vol. III (1904), p. 44, figs. I place this species in Del Guercio's genus *Cerosipha* on the authority of Mr. H. F. Wilson. I have not seen the description of this genus, which Mr. Wilson has kindly informed me is in "Nuove Relazioni R. Stazione di Entomologia Agraria di Firenze, 1900, p. 116." This species is very common in Illinois, curling and injuring the foliage of the cultivated and wild blackberry.

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[1]Exceptions:—one individual had segment VI filament 0.024 mm. shorter than III, and another had VI filament and III of equal length.

[2]Carbondale, Ill., and Fort Dodge, Ia., are the type localities.

Thomas makes no mention as to the type locality of this species, but supposedly it was collected by him in Illinois.

Toxoptera graminum Rond.: Hunter, Bull. Univ. Kans., Vol. IX, No. 2 (1909), 221 pp., 66 figs., 9 pls., 3 col. pls. Ordinarily this species does not become injuriously abundant in Illinois, but occasionally it damages grain in southern and parts of western Illinois. First reported by Forbes.

**Hyadaphis pastinacæ* Linn.: ? Monell, Bull. U. S. Geol. and Geog. Surv., Vol. V, No. 1 (1879), pp. 26–27. (*Rhopalosiphum salicis*). Weed, Trans. Amer. Ent. Soc., Vol. XX (1893), p. 297 (*H. salicis*). This species I have taken on *Zizia aurea*, garden parsley, and *Salix*, in Illinois. On the parsley they became so abundant as to noticeably damage it. According to Schouteden the following synonyms have already been recognized,—*aegopodii* Scop., *capreæ* Fabr., *cicutæ* Koch, *umbellatorum* Koch: It is with some hesitation that I add another species (*H. salicis* Monell) to the already long synonomy. All of the *Hyadaphis* which I have found on *Salix* agree well with the descriptions of *pastinacæ* and with the specimens taken on *Zizia aurea* and parsley. Also Mr. Monell has kindly made a careful examination of the type slides and in a letter dated October 14, 1910, he says, "I have just looked at it [type slide of *H. salicis*, collected June 15, 1878] under a ¾ objective, and I cannot see the tubercle [referring to a small acute tubercle on the dorsum of the penultimate abdominal segment and projecting caudad, a character which appears to be found in no other species of this genus] on specimens mounted back up but luckily one specimen is mounted sideways and I can see the 'horn' plainly. My recollection is this was quite a common species in 1878–1879, but now we seem to find only isolated specimens in colonies of the *Ch. viminalis*." In an earlier letter (October 6, 1910) Mr. Monell gives some interesting compiled data which I copy verbatim. "This *S. capreæ* [=*pastinacæ*] on willow and *Umbelliferæ* does not seem to be an 'alternation' of food plants as witness these dates —

On willow.

In April, Kaltenbach's Monograph.
June 11, '77. Willow, Pergande notes, St. Louis, Mo.
June 15, '78. 150*o* St. Louis, Mo. Old types of *Rh. salicis*.
May 25, '86. 341*x* St. Louis, Mo.
Oct. 1, '10. Collected by Davis at St. Louis, Mo. [winged].
[Aug. 4, '09. Oak Park, Ill. Apterous only.]

On *Umbelliferæ*.

May 22, '07. On *Thaspium*, 539x, St. Louis, Mo. Apterous only.
June 19, '07. On *Heracleum*, 548, St. Louis, Mo. Apterous only.
July 1, '10. On garden parsley, 830x, Chicago, Davis, Apt. and winged.

Mar. 4, '91. *Aphis pastinaci* on celery, Washington (State?). Insect Life, Vol. IV, p. 213.

[Oct. 1, '08. On *Zizia aurea*, Chicago, Ill. Apt. and winged.]

The following average measurements from three collections may be of interest:

Collection data	Antennal measurements in mm.					Sensoria
	III	IV	V	(VI)	(VII)	
Garden parsley, July 1, 1910, Chicago, Ill.	0.34	0.13	0.13	0.13	0.16	Sensoria only on III.
Zizia aurea, Oct. 1, 1908, Chicago, Ill.	0.34	0.10	0.08	0.08	0.12	Sensoria on III and IV.
Willow, Oct. 1, 1910, St. Louis.	0.44		0.08	0.08	0.10 broken off	Sensoria on III and IV

In his description of the winged male and wingless oviparous female of *H. salicis* in Transactions of the American Entomological Society, Vol. XX (1893), p. 297, Weed mentions the characteristic abdominal tubercles referred to above. Camera lucida drawings of the tubercles or "horns" are given in Plate 32, figure 20 from the wingless viviparous female (a = tubercle; b = style) and figure 21 from the winged viviparous female, both drawn to the same scale.

Oestlund's *H.* (*Siphocoryne*) *archangelicæ* may also prove to be a synonym of *pastinacæ*.

**Hyalopterus arundinis* Fabr.: Oestlund, *loc. cit.* p. 44 (*phragmitidicola*). This species is exceedingly common in northern Illinois, where it thickly colonizes the leaves, usually on the upper surfaces, and along the mid-rib of *Phragmitis phragmitis*, which grows abundantly along country roadsides.

Rhopalosiphum berberidis Fitch: Davis, Annals Ent. Soc. Amer. Vol. I (1908), p. 254, figs. A common and often abundant species, occasionally in such numbers as to injure the barberry (*Berberis vulgaris*), a useful shrub in ornamental plantings. First reported by the writer.

R. nymphaeæ Linn.: Jackson, Ohio Naturalist, Vol. 8 (1908), p. 243, 1 plate. (*Aphis aquaticus*). In conservatories it often becomes quite troublesome on *Philotria canadense* and calla. Out-of-doors it is a common aphid on water plants such as *Nymphæa*, *Sagittaria* and *Lemna*. First reported by the writer.

**R. rhois* Monl.: Sanborn, Kans. Univ. Sci. Bull., Vol. III, No. 1 (1904), p. 64, figs. Often becoming exceedingly abundant on ornamental sumach, seriously disfiguring and weakening the plants.

[t]*R. solani* Thos.: 8th Rep. State Ent. Illinois (1880), p. 73. Have never taken this species, but an examination of the types in the State Laboratory of Natural History proves it to be a distinct and good species. First reported by Thomas.

**R. sonchi* Oestl.: 14th Ann. Rep. Geol. and Nat. Hist. Surv. Minn. (1886), p. 34. Found on *Sonchus* rather commonly in northern Illinois.

**R. violæ* Perg.: Can. Ent. Vol. 32 (1900), p. 30. I found this species quite common on cultivated violets in a greenhouse at Peoria, Ill., September 24, 1910, the first and only record we have of its occurrence in Illinois.

[d]*M. achyrantes* Monl.: Bull. U. S. Geol. and Geog. Surv., Vol. V, No. 1 (1879), p. 18. Pergande[1] questionably places this species as a synonym of *M. mahaleb* and Gillette[2] has considered it the same as *M. persicæ*. I am unacquainted with the species. First reported by Forbes and Hart.

M. cerasi Fabr.: Weed, Bull. Ohio Agr. Exp. Sta., Tech. Ser. Vol. I, No. 2 (1890), p. 111; Gillette, Jour. Econ. Ent. Vol. I (1908), p. 362, col. figs. First reported by Thomas.

M. elæagni Del Guer.: Gillette, Can. Ent., Vol. XL (1908), p. 17, figs. (*M. braggii*); Davis, Annals. Ent. Soc. Amer., Vol. I (1908), p. 251, figs. A common species attacking ornamental Russian olive (*Elæagnus augustifolia*) and *Shepherdia argentea*, and although often becoming quite abundant, seldom injures the plants attacked. First reported by the writer.

M. persicæ Sulz. (=*Rhop. dianthi Schr.*): Gillette, Jour. Econ. Ent., Vol. I (1908), p. 359, col. figs. A very common and often pernicious pest in gardens and greenhouses, those plants which I have found it damaging most being cultivated snap dragon, carnation and ornamental pepper in greenhouses; and cabbage, spinach, and egg plant in the vegetable garden. I have examined what are probably the types of Thomas' *Rhop. tulipæ*, and they prove to be *persicæ* Sulz. First reported by Thomas.

**M. plantagineus* Pass.: I have taken this species on the common plantains (*Plantago rugelii* and *P. major*) on several occasions at Urbana, LeRoy, and Aurora. It lives on the base of the leaf stalks, on the under surface and near the ground, the aphid colonies often being covered with a "tent" of earth and débris constructed by the ants in attendance, usually the common field ant (*Lasius n. americanus*). Its habits are very much like those of the clover aphis (*A. bakeri*). Doctor Mordwilko, to whom specimens were sent, has

[1]Bull. U. S. Dept. Agr., Div. Ent. No. 7 (1897), p. 52.

[2]Bull. Colo. Agr. Exp. Sta. No. 133 (1908), p. 32.

confirmed the writer's determination. I believe this species has not heretofore been reported from the United States.

The following descriptions were made from specimens collected at Urbana, Ill., July 15, and August 7; LeRoy, Ill., June 22; and Aurora, Ill., September 24.

Winged viviparous female.— Head (Pl. 32, fig. 22) and thorax dark, abdomen pale green with a reddish area around each cornicle. Eyes black. Antennæ on frontal tubercles, typical of the genus *Myzus;* subequal to or slightly longer than the body; filament VI longest, it being nearly ¼ longer than III, III nearly 1-3 longer than IV which is subequal with segment V, base VI 1-4 length of the filament or 1-3 length of III; 11–17 circular sensoria, usually more or less in a row on segment III, the usual ones at ends of V and base VI (in one specimen there were two small sensoria on segment IV); slightly imbricated, bare, and dusky to blackish excepting the two paler basal segments and basal end of III. (Pl. 32, fig. 26.) Wings with dark and conspicuous venation, the first and second discoidals branching at a little less than 2-3 the distance from where the third branches, to the tip of wing. (Pl. 32, fig. 25.) Legs pale excepting tarsi which are black. Cornicles pale, reaching to or slightly beyond tip of style, narrowest in middle and the tip very slightly swollen. (Pl. 32, fig. 23.) Style pale, typical of the genus, and about 1-2 the length of the cornicles. (Pl. 32, fig. 24.)

Measurements.— Length of body, 1.27 mm.; width, 0.55 mm.; length of wing, 2.22 mm.; width, 0.80 mm.; antenna, I, 0.065; II, 0.055; III, 0.375; IV, 0.277; V, 0.277; VI, base, 0.130; VI, filament, 0.49; total, 1.669 mm.; cornicle, 0.275 mm.; style, 0.130 mm.; hind tarsus, 0.114 mm.

Wingless viviparous female.— Body cream colored to pale brownish yellow, the abdomen having also a distinct but very slight greenish tint. A small red area at the base of and around each cornicle. The red eyes of the embryonic aphids within the body are visible through the dorsal abdominal wall of the mature female. Eyes brownish black to black. Antennæ concolorous with the body excepting the dusky tip of IV, and also tip of V and all of VI, which are black; slightly longer than length of body, relative antennal lengths as in winged. (Pl. 32, fig. 27.) Legs pale or with a very pale brownish tint, and the tarsi black. Cornicles and style as in the winged.

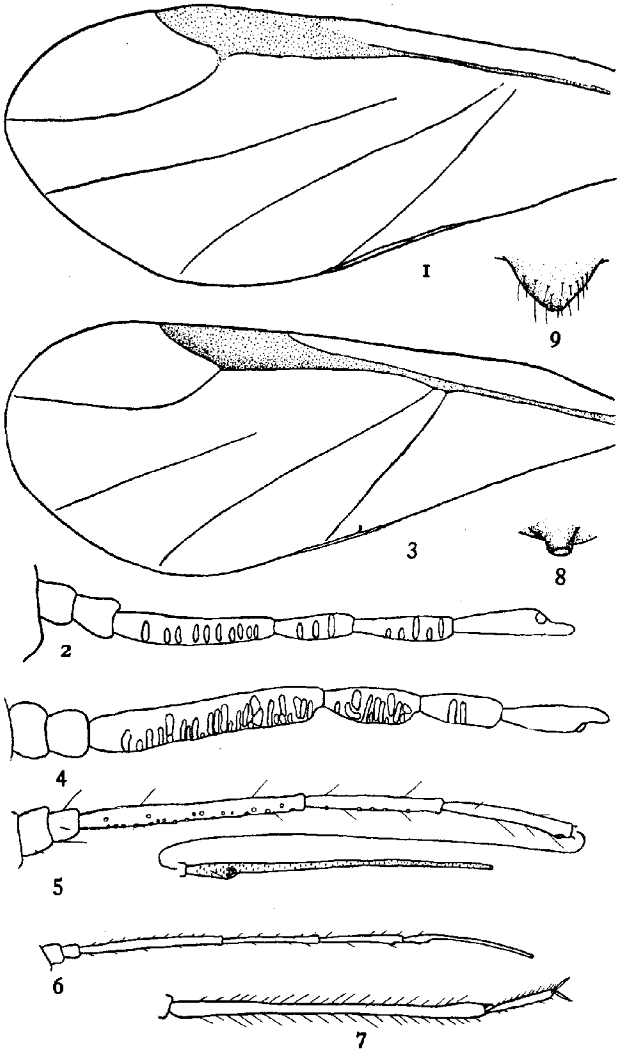
Measurements.— Length of body, 1.6 mm.; width, 1.05 mm.; antenna, I, 0.075; II, 0.57; III, 0.407; IV, 0.277; V, 0.277; VI, base, 0.130; VI, filament, 0.489; total, 1.712 mm.; cornicle, 0.358 mm.; style, 0.135 mm.; hind tarsus, 0.114 mm.

**M. ribis* Linn.: Oestlund, Bull. Geol. and Nat. Hist. Surv. Minn., No. 4 (1887), p. 74. Common throughout the state, and frequently a pest on the cultivated currant.

**M. rosarum* Walk.: Oestlund, 14th Ann. Rep. Geol. and Nat. Hist. Surv. Minn. (1886), p. 30 (*M. potentillæ*). A rose pest commonly found in Illinois on roses in greenhouses. They colonize the tender shoots, sometimes completely covering them and naturally killing the growth.

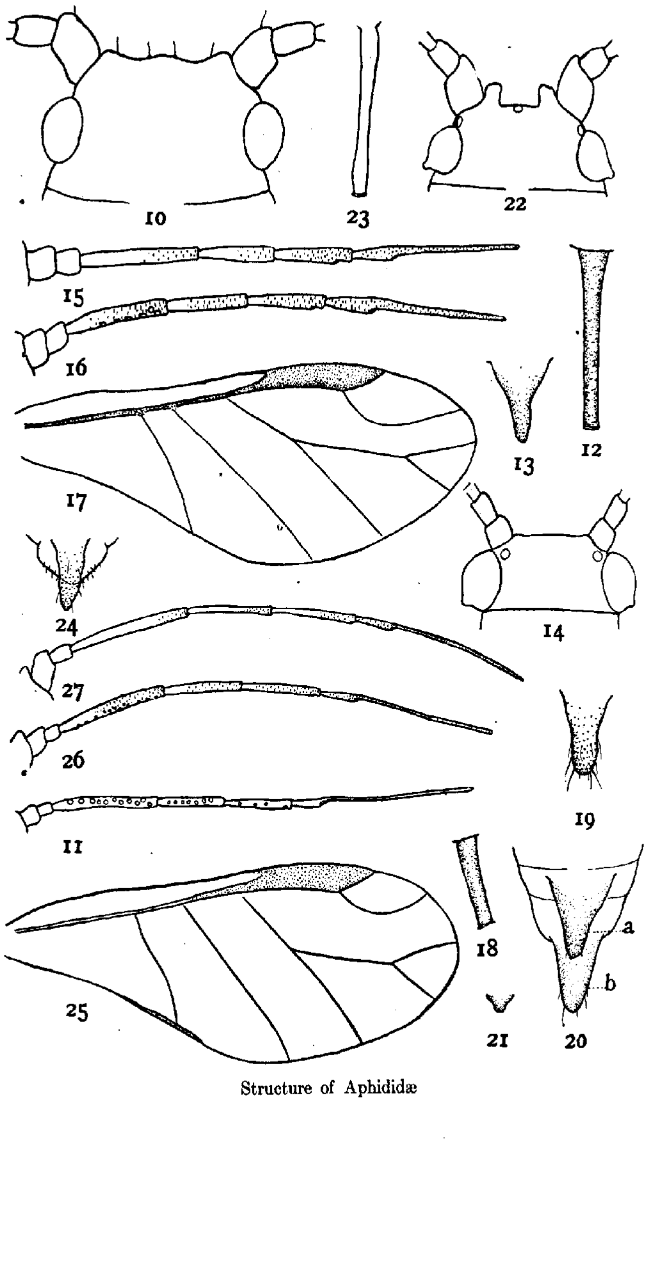
(*To be concluded*)

Plate 31



Structure of Aphididæ

Plate 32



Structure of Aphididæ

Explanation of Plates 31 and 32.

Pemphigus corrugatans Sirr.—Fig. 1, wing; 2, antenna of winged viviparous female.

P. pyri Fitch (??).— Fig. 3, wing; antenna of winged viviparous female.

Aphis houghtonensis Troop.— Antenna of winged viviparous female.

A. lonicerœ Monl.— Fig. 6, antenna; 7, hind tibia and tarsus; 8, cornicle; 9, style; 10, head of wingless viviparous female.

A. coreopsidis Thos.— Fig. 11, antenna; 12, cornicle; 13, style of winged viviparous female.

A. spirœella Schout. (?) — Fig. 14, head of winged viviparous female; 15, antenna of wingless viviparous female; 16, antenna; 17, wing; 18, cornicle; 19, style of winged viviparous female.

Hyadaphis pastinacœ Linn.— Fig. 20, abdominal tubercle on the wingless viviparous female; 21, on the winged viviparous female.

Myzus plantagineus Pass.— Fig. 22, head; 23, cornicle; 24, style and anal plate; 25, wing; 26, antenna of winged viviparous female; 27, antenna of wingless viviparous female.

Camera lucida drawings, figures 5, 8, 9, 10, 12, 13, 14, 15, 16, 18, 19, 20, 21, 22, 23, 24, with a one inch eyepiece and two third objective; 6, 7, 11, 26, and 27 with a two inch eyepiece and two third objective; 17 and 25 with one inch eyepiece and one and one half objective. Figure 3 is drawn to a scale about one third smaller than 1. Figure 2 and 4 are drawn to the same scale.

THE NEW FRENCH EXPORT PLANT INSPECTION SERVICE

By L. O. Howard

On page 76 of the current volume of the Journal of Economic Entomology (February, 1910) occurs an abstract of remarks made by the writer on the subject of European conditions as affecting nursery stock, in which it was shown that the French government had promised to establish a governmental inspection service in France, under the Ministry of Agriculture. These remarks were made at the Eighth Annual Meeting of Horticultural Inspectors at Boston, on December 26, 1909.

Early in November there was received at the Department of Agriculture through the French Ambassador to the United States and the U. S. Department of State, a statement to the effect that the service had been established, and transmitting more or less detailed information from the official journal of the French Republic. Information was conveyed that Dr. Paul Marchal, director of the Agricultural Entomological Station at Paris, had been placed in charge of the work, and the hope was expressed that the service established would be satisfactory to the government of the United States, on the understanding that the arrangement will not affect the right of the United States to examine shipments of living plants, where necessary.

Following this information, a letter was received at the Bureau of Entomology, dated October 27, from Doctor Marchal, and addressed to the writer. Translated excerpts from this letter, which will be of interest to State and Experiment Station entomologists and to horticultural inspectors, may be quoted as follows:

"As you have already been informed by the Minister of Agriculture, I have been officially charged with the delivery of the accompanying certificates upon material exported by nurserymen to the United States, who demand a phytopathological inspection. I myself visited from the 9th to the 13th of October the nurseries in the neighborhood of Nantes, Angers and Orleans. At Nantes and at Angers I was accompanied by Mr. Vuillet, of Rennes, and we examined together a very great number of plots. In spite of all of our care, we have not found any eggs of *dispar*, and in my whole journey I found only four nests of *chrysorrhœa*. Everywhere I have given a description of the insects, and recommended the greatest care. The certificates which I will give will be in accordance with the models enclosed. They will shortly be printed. No. 1 will be in the most demand, and is to be attached to the sendings of nurserymen having plots belonging to them and under their direct care. While the certificate makes mention only of plots, and not of sendings, I reserve for myself the right to make visits at the time of shipment or of packing, or any time when I can form the best judgment. These visits will serve to check an inspection of the plots themselves. I have limited the certificate to the plots without speaking of the sendings on account of the impossibility I would find of inspecting one by one all of the packages which are sent. The important point, aside from the inspection of the plots themselves, is that if the nurserymen know that an inspector can come at any moment they will be much more careful."

"Certificate No. 2 is destined for exporters who have no plots belonging to them or under their direct eye, and it implies at least one visit of inspection for each sending. I have named as inspector for the region of Nantes and Angers, Mr. Vuillet of Rennes, who always does his work with great conscientiousness. I have seen him at work, and I appreciate his competence. In all probability he will also be charged with the region of Ussy, which I intend to personally visit within a few days. My assistant, Mr. Guinaux, will take the region of Orleans. I myself and Mr. LeCerf will attend to the region about Paris. Finally I count on Mr. Poirault, director of the Villa Thuret, at Antibes, a very distinguished biologist and botanist, for the southern region.

"I desire that in future the provisional organization which has been instituted should be completed and become permanent, but in order

to bring this about it is first necessary that the nurserymen themselves should not be obliged to pay the expense, but that a government phytopathological service should be created having a special budget provided by the state. In the meantime, in order to have the plantations more and more healthy, I count upon the instruction which we are giving and upon training in the methods to be employed. We will do our best to make the nurserymen more careful in their operations and to see that they employ the proper means for the destruction of the enemies of plants.

"Around Paris I have found that a certain number of large nurserymen take pains to wash the trees at the time of packing with black soap or with a solution of lysol. They remove thus many winter eggs and Coccidæ which are found on the bark, but this precaution is nearly a certain guarantee that they will not allow a nest of *chrysorrhœa* or an egg-mass of *dispar* to go out. It is unfortunately much more difficult to get such care taken in the region where they produce the plants in enormous quantity and very cheaply, for it is evident that any additional expense will oblige the nurserymen to go out of business. To spread among them a knowledge of *chrysorrhœa* and *dispar*, I have distributed a short circular, with figures representing these insects and particularly the nest of *chrysorrhœa* and the egg-mass of *dispar*."

This movement on the part of the French government is one in the direction of coöperative assistance between France and the United States, and Doctor Marchal's high reputation in this country is in itself a guarantee of the thoroughness of the examinations upon which his certificates will be based.

Two forms of certificates mentioned in his letters are as follows:

(No. 1.) The undersigned, director of the agricultural entomological station of Paris, does hereby certify that the nurseries of M............................ nurseryman at................................were inspected and that, to his knowledge, the plantations show no indication whatever of any species of insects (especially gypsy moth and brown-tail moth), considered as dangerous, or of any disease able to be transferred to orchards or nursery stock.

THE DIRECTOR OF THE AGRICULTURAL
ENTOMOLOGICAL STATION OF PARIS.

(No. 2.) The undersigned, director of the agricultural entomological station of Paris, does hereby certify that the sendings of M.............................. horticulturist at..................................were inspected and that, to his knowledge, they show no indication whatever of any species of insects (especially gypsy moth and brown-tail moth) considered as dangerous, or of any disease able to be transferred to orchards or nursery stock.

THE DIRECTOR OF THE AGRICULTURAL
EXPERIMENT STATION OF PARIS.

The observations mentioned by Doctor Marchal as having been made on the occasion of the trip of himself and Mr. Vuillet to western France and Orleans afford an interesting confirmation of the observations made by the writer in June in the same region. Not a single nest of the brown-tail moth was discovered and no trace of the gypsy moth in any of the nursery-growing regions. In fact, during the past summer, lepidopterous larvæ of all kinds were exceedingly rare in northern France. This, however, need not be taken as a ground upon which to base careless inspection of imported stock the coming winter.

INSECTS OF THE YEAR 1910 IN IOWA

By R. L. Webster

The weather conditions during the past season in Iowa have been exceptionally adapted for the abundance of several insect pests. The warm month of March, followed by continued cool weather, and the long period of drought during the summer, caused many insects to become very common. The insects I will take up in a more or less chronological order, as they were found during the season. The first thing that I have to record, however, has nothing to do with the peculiar weather conditions this year. This is the finding of the clover leaf-weevil in Iowa.

Phytonomus punctatus Fabr. This insect has been gradually working westward ever since its importation from Europe and I have been expecting to find it in Iowa every year. In April, 1910, I spent a few days around Burlington, which is on the Mississippi River in the southeastern part of the state. I found no traces of the insect on the high ground back from the river, but I did find larvæ fairly common in a clover field in the river bottoms, a couple of miles north of Burlington. These larvæ were taken to the insectary at Ames and the beetles were subsequently reared, these emerging May 12th to 24th. So far as I know this is the first occurrence of this insect west of the Mississippi, with one exception, at Vancouver, B. C., which may be an artificial importation. The insect reached Illinois from the east about 1903.

Pegomya fusciceps Zett. On account of the very warm weather in early spring corn planting began very early. But it turned cool again for several weeks and during this period much damage was done by the seed-corn maggot. By the middle of June most of the maggots had matured and the adult flies emerged towards the latter part of that month. The most injury was in the earlier planted fields, where

the corn remained in the ground for some little time before it germinated.

Sphenophorus parvulus Gyll. During June much complaint was made of injury to young growing corn plants by bill bugs. In one field near Whiting, Monona County, I found practically 100% injury by this insect. The field was in sod the year previous and had been turned under that spring. Out of 100 hills in a row, counted consecutively, every hill was more or less injured by the punctures of bill bugs. The species here concerned was *Sphenophorus parvulus.*

Aphis setariæ Thos. Plum trees over the state were badly infested with this species of aphid this year. Probably the worst infestation noticed was at Ames. Here the insect reached its maximum about the middle of June, when the plant lice were so thickly crowded on young plum growth so as to quite hide the wood. One's clothes would become stained by the aphids while walking down a row of badly infested young trees. Early in July lady beetles, mainly *Coccinella 9-notata* Herbst and *Hippodamia convergens* Guer., were very abundant on the infested trees and by July 29th on some of these trees not an aphid could be found. A part of them, no doubt, had migrated to their alternate food plants among the wild grasses, but it was the abundance of the lady beetles that was responsible for the wholesale clearing out of the plant lice.

Leptinotarsa 10-lineata Say. This year the ever-present Colorado potato-beetle was much more common than usual. Early in the season many potato fields were threatened with a stripping, but the use of Paris green in most cases checked the insects.

Epitrix cucumeris Harris. Another insect that was very common on potatoes in Iowa this year was the potato flea-beetle. The injury was first noticed about the middle of June. The beetles were found on the vines from that time until fall. Early potatoes were more injured than the late varieties.

Empoasca mali LeBaron. The apple leaf-hopper also did considerable damage this year to potatoes. The attacks of this insect, together with the injury by the Colorado potato-beetle and the long drought, made potatoes a very poor crop in some localities.

Chaitophorus negundinis Thos. Box elder trees all over the state were attacked by the box elder aphid, which seems to be fairly common in Iowa nearly every year. The plant lice evidently got a start early in the season, when the late frost took all the foliage from the trees, but apparently did not affect the insects. Many trees were not able to put out a full foliage all through the season, due to the attack of this aphid and also to injury by a species of Eriophyes.

Meliana albilinea Hübner. Injury to timothy heads by the wheat-

head army-worm was very common in the northern half of the state this year. This was part of an outbreak that extended into Minnesota and eastern South Dakota. The damage was more serious than it has been for years. In some cases oats were also slightly damaged, but most of the injury was to the timothy. From a series of observations it was found that early fall pasturing of infested meadows greatly decreased the injury in those meadows the following year. Apparently the stock eat the grass down so well that the larvæ of the second generation in the late summer are practically starved out.

Peronea minuta Rob. Several nurseries in the state are again having trouble with the lesser apple leaf-folder. The second and third generations of the leaf-folders were exceptionally numerous.

Grasshoppers became abundant during the summer, especially in meadows and along roadsides. There were two species that were most abundant: *Melanoplus femur-rubrum* DeG., and *Melanoplus bivittatus* Say.

Scientific Notes

An Unusual Invasion of Aedes sollicitans in Louisiana during July, 1910.—On July 12, 1910, notes were made on a very unusual abundance of *Aedes sollicitans* in Pointe Coupee Parish, Louisiana. For several weeks before and after that date all field operations were suspended on account of the mosquitoes. Ordinarily negroes pay no attention to mosquitoes. They very seldom have mosquito bars in their cabins. At this time, however, it was impossible for the managers to force the negroes to work in the fields. Live stock suffered very severely. The cattle from the pastures and woods assembled on high places like the levees. Here they galloped back and forth through the night. The mosquitoes were less abundant in the daytime at least when the sun was shining. During cloudy weather in daytime they appear to be as active as at night. Some animals, more susceptible than others, were attacked to such an extent that the hair was all saturated with blood.

In company with one of my agents and two other men I went into the cotton field on the afternoon of July 12th with a large number of negroes in order to apply poison. The negroes had to be forced to go to the field. During the short time we were able to stay in the field all the members of the party attempted to protect themselves from the mosquitoes by moving the arms violently and stamping the feet. The negroes were as active in this as the white members of the party. In spite of what was done it is very doubtful if, for a single instant, there were less than 100 mosquitoes on each member of the party. Something over a pound of oil of citronella was used but it had little effect. After about half an hour spent in the field, we were compelled to return to the headquarters. Upon nearing the store one of the men frantically jumped from the wagon and ran to seek shelter. He stated that every puncture gave him extreme pain. In my own case no sharp pains were experienced and there were no unusual after-effects.

W. D. Hunter,
Bureau of Entomology, U. S. Department of Agriculture.

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

DECEMBER, 1910

The editors will thankfully receive news items and other matter likely to be of interest to subscribers. Papers will be published, so far as possible, in the order of reception. All extended contributions, at least, should be in the hands of the editor the first of the month preceding publication. Reprints may be obtained at cost. Contributors are requested to supply electrotypes for the larger illustrations so far as possible. The receipt of all papers will be acknowledged.—Eds.

The dedication of an admirably equipped building, noticed on other pages of this number, to the training of young men in entomology marks another advance in the rapid progress this science is making in America. Special buildings are provided only when necessary, the need in turn depending largely upon the demand for such technical knowledge and not a little upon the ability of those responsible for the training of the students. The splendid structure recently completed at the Massachusetts Agricultural College is a worthy monument to the ability of a beloved veteran, Prof. C. H. Fernald, who unfortunately has been obliged, on account of ill health, to retire from active teaching. Nearly a quarter of a century of work has made it possible for him to exercise through his students a profound influence upon the development of American economic entomology. It is a pleasure to note that the development of the department he has been so largely instrumental in building up is to be continued along progressive lines. We confidently look for a maintenance of the present high standards and take this opportunity of congratulating the institution upon the possession of such an admirably equipped department.

Schools giving special training in entomology, particularly its economic or practical aspects, are a comparatively recent development, yet excellent is the adjective which must be applied to much of the earlier work by men compelled to fit themselves progressively for the solving of various problems. Considering the numerous handicaps under which our earlier workers labored, it is a question whether any could have done much better. They have laid a solid foundation upon which all subsequent students must build. The enormous development of recent years has been made possible by conditions beyond our control, namely, extended and serious depredations following the normal development of a comparatively new country. The demand for knowledge has stimulated the training of men and, as a result, we have in America unrivaled opportunities for the study of applied entomology, not only in the university and college but

also throughout the country. The investigations of special problems by corps of well trained men means the making of entomological history which will have a profound influence upon our future welfare. The relative importance of different phases of this work can not be accurately estimated at the present time. It will be interesting, a generation or so later, to make a critical comparison between the work of our pioneers and those who have had the advantage of the best training a university or special school can bestow.

Reviews

The Coleoptera or Beetles of Indiana, by W. S. BLATCHLEY, Ind. Dep't of Geol. and Nat. Resources, Bul. 1, p. 1–1386, 590 figures. 1910.

The beetle book has appeared and marks a most important step in further popularizing our knowledge of this extensive order. The author follows the classification of LeConte and Horn and with the coöperation of specialists in many groups has produced a most creditable publication and incidentally laid all entomologists under obligation. The scope of the work, describing as it does, over 2,500 species, compels brevity. Only 24 pages are devoted to introductory matter and that is mostly morphological. The remaining pages consist of a descriptive catalogue exclusive of the Rhynchophora, of all species known to occur in Indiana. Tables are given for the separation of families, tribes, genera and species. The descriptions, though brief, are sufficient for the recognition of most species. Citations of the more valuable papers for both groups and genera and a glossary add much to the value of this work. The large number of illustrations taken from various sources add greatly to the value of the work, though its appearance is somewhat marred by their miscellaneous character.

This work is indispensable to working entomologists, since it is the first attempt known to us to produce a systematic account of the beetles occurring in any representative life zone of America. It will be especially valuable to those in the Central States and of great service to others in approximately the same faunal area. We regret to note that it has been possible to issue only 1,000 copies of this bulletin. The author is to be congratulated upon having completed such an extensive work and it is to be hoped that he will soon be able to publish a similar account of the Rhynchophora.

Insects and Diseases, by RENNIE W. DOANE, Henry Holt & Co., p. 1–227, figures 112. 1910.

This timely, popular work brings together the most important facts, largely from sources inaccessible to the general reader and even to many physicians and entomologists, in regard to the development, habits, structure, life histories and methods of controlling the insects discussed. This little volume illustrates anew the economic importance of the Diptera, since about one half of the text is devoted to discussions of various flies and methods of controlling them. The house or typhoid fly and various mosquitoes, especially the forms conveying malaria and yellow fever, are treated in considerable detail. The chapter on ticks and mites and their part in the dissemination of disease is exceptionally interesting. The chapter devoted to fleas

and plague with its account of conditions obtaining upon the Pacific coast is most pertinent. The excellent series of illustrations, for the most part original, adds much to the value of the volume. The value of this work to the professional entomologist at least, is greatly increased by the somewhat extended and carefully selected bibliography. Only a few errors have been noted. Through an oversight the sexes have been wrongly indicated in figures 76 and 77, while the name of one author cited is given in two different forms, neither correct. The volume as a whole will be found of great service, not only to those desiring a general knowledge of the subject, but also to professional entomologists who may wish to look up the original sources of information.

Current Notes

Conducted by the Associate Editor

Mr. H. F. Wilson of the Bureau of Entomology has resigned to accept a position under Prof. A. B. Cordley at the Agricultural Experiment Station, Corvallis, Oregon.

Mr. John D. Tothill, formerly of the Ontario Agricultural College, Guelph, has been appointed assistant in the Bureau of Entomology of the U. S. Department of Agriculture and has been working since July 1, 1910, on Tachinid parasites of the gypsy moth at the parasite laboratory at Melrose Highlands, Mass.

Dr. Alexander Petrunkevitch of the American Museum of Natural History has been appointed instructor in zoölogy in the Sheffield Scientific School of Yale University.

J. C. Bridwell, instructor in zoölogy and entomology at the Oregon Agricultural College and assistant entomologist of the Station, has resigned to accept a similar position at the University of California.

According to the *Experiment Station Record*, Mr. Charles R. Jones, formerly of the Bureau of Entomology, has accepted an appointment as entomologist to the Philippine Board of Agriculture at Manila, P. I.

According to *Entomological News*, Mr. C. B. Hardenberg, formerly connected with cranberry insect investigations for the State of Wisconsin and for the U. S. Department of Agriculture, has been appointed entomologist to the Transvaal at Pretoria.

Prof. John B. Smith of Rutgers College, and state entomologist of New Jersey, sailed for Europe, August 20, and returned about the middle of October.

According to *Science*, Folsom's "Entomology" has been translated into Japanese by Messrs. Miyake and Uchido of Tokyo.

In the course of lectures on public health problems and the prevention of disease to be given at Teachers' College, Columbia University, one lecture on "Flies and Other Insects as Carriers of Disease" is scheduled for December 5, the lecturer to be announced later.

Harry Evans, assistant entomologist at the Kansas Station, has resigned to accept a position at the Ohio Station.

J. S. Houser, assistant entomologist of the Ohio Station, has been granted a year's leave of absence for post-graduate study at Cornell University.

Mr. H. O. Marsh, agent and expert of the Bureau of Entomology, and engaged in truck crop investigations, resigned his position June 30, 1910.

Mr. W. R. Walton, scientific artist of the Laboratory of Economic Zoölogy at Harrisburg, Pa., has resigned to accept a similar position in the Bureau of Entomology at Washington, D. C.

Prof. H. A. Surface, economic zoölogist of Pennsylvania, conducted a series of public meetings in the model orchards throughout the state during the fall. The results of the spraying experiments and demonstrations were studied and explained.

According to the *Experiment Station Record*, Mr. D. L. Van Dine of the Bureau of Entomology, and formerly of Honolulu, T. H., has been appointed entomologist of the Porto Rico Sugar Producers' Station, with headquarters at San Juan.

Miss C. F. Kephart, B. S. A., a graduate of Cornell University in the class of 1910, and for two years before graduation a student assistant in entomology, has been appointed assistant in the entomological department of the New Hampshire College of Agriculture and the Mechanic Arts.

Mr. W. S. Abbott, who graduated last June from the New Hampshire College, has accepted the position of assistant entomologist at the New Jersey Agricultural Experiment Station, New Brunswick, N. J.

Mr. F. A. Johnson, of the Bureau of Entomology, has been assigned to work at the Virginia Truck Station in place of E. G. Smyth, who has been transferred to other work of the Bureau.

The Board of Directors of the Agricultural and Mechanical College of Texas, College Station, Texas, have recently reëstablished the Department of Entomology in that institution. In 1909 the teaching of entomology was placed in the hands of the Biological Department and was under the supervision of the professor of botany. Under the new arrangement the department of entomology is separate and distinct, with Mr. Wilmon Newell as professor of entomology and Mr. Ernest E. Scholl as assistant professor.

Mr. Arthur I. Bourne, a graduate of Dartmouth College, who took a year of graduate study at the Massachusetts Agricultural College and for the past year has been assistant in the Bureau of Entomology at Washington, has returned to the college at Amherst as assistant in entomology. Mr. Bourne will also continue his studies in the graduate school.

The new building for entomology and zoölogy at the Massachusetts Agricultural College at Amherst, Mass., was dedicated November 11, the principal addresses being given by Dr. L. O. Howard, chief of the Bureau of Entomology at Washington, and Dr. W. E. Hinds of the Alabama Polytechnic Institute, Auburn, Ala. A brief account of the exercises and a description of the building appear on other pages of this number of the JOURNAL. Among other entomologists present besides those residing at Amherst were noticed Dr. E. P. Felt, Albany, N. Y., Mr. H. E. Hodgkiss, Geneva, N. Y., Dr. W. E. Britton and Mr. D. J. Caffrey, New Haven, Conn., Mr. C. W. Johnson and Mr. D. M. Rogers, Boston, Mass., Mr. A. F. Burgess, Melrose Highlands, Mass., Mr. A. H. Kirkland, Huntington, Mass., Mr. H. J. Franklin, Wareham, Mass., and Mr. H. L. Frost, Arlington, Mass.

JOURNAL ECONOMIC ENTOMOLOGY PUBLISHING COMPANY

The annual meeting of the stockholders of this company will be held on December 28 or 29, in connection with the meeting of the Association of Economic Entomologists at Minneapolis, Minnesota. The precise time and place will be announced at the sessions of that Association. Members of the advisory board are hereby notified that it devolves upon them to nominate the elective officers.

E. P. FELT, *President.*
E. DWIGHT SANDERSON, *Secretary.*

Mailed, December 15, 1910.

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TWENTY-THIRD ANNUAL MEETING OF THE AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

Minneapolis, Minnesota, December 28–29, 1910

The twenty-third annual meeting of the American Association of Economic Entomologists will be held at Minneapolis, Minn., on Wednesday and Thursday, December 28 and 29, 1910. The sessions will open at 10 a. m., Wednesday, in Room 24, *School of Mines Building* of the University of Minnesota. At 1 p. m. a joint session will be held with the Entomological Society of America and on the following day sessions will be held in the same room at 10 a. m., and 1 p. m.

If the weather is favorable and the members desire it one of these sessions can be transferred to the Minnesota Agricultural College. This arrangement will give the members an opportunity to inspect the buildings and equipment of the college and to examine the laboratory and equipment of the state entomologist of Minnesota. This matter will be decided at the first session on Wednesday morning.

Other Meetings

The American Association for the Advancement of Science and its affiliated societies will hold meetings throughout the week at the University of Minnesota.

The Entomological Society of America will meet on Tuesday, December 27, and in joint session with this association on Wednesday, December 28, at 1 p. m. The public lecture held by the society will be delivered by Prof. F. L. Washburn, state entomologist of Minnesota, on Wednesday evening. At the close of this meeting an informal smoker will be held in the Dyckman hotel.

The Association of Horticultural Inspectors will meet at 8 p. m., Thursday, and the sessions will be continued on Friday.

Hotel Headquarters

The hotel headquarters of this association and the Association of Horticultural Inspectors will be at the Dyckman, on Sixth Street between Nicollet and Hennepin Avenues. Rates, $1.50 to $4.00 a day on the European plan. Our headquarters are located in the block adjoining the Radisson, the hotel headquarters of the Amer-

ican Association for the Advancement of Science. Members are urged to secure hotel reservations in advance, as the hotel management request that reservations should be made at least ten days before the meeting.

Railroad Rates

All railroad lines have declined to grant reduced rates for the meeting.

Announcement Concerning Program

A full program of the meeting will be published in the general program issued by the American Association for the Advancement of Science. Each member attending the meeting on *payment of dues* will be furnished with the official button of the association and a special program of the meeting.

In accordance with the action of the executive committee symposia have been arranged on " Present Methods of Teaching Entomology " and on " Spraying Machinery—Its Present Desirable and Undesirable Features." These subjects will be presented by some of the best-known entomologists of this country and will be a special feature of the meeting. In connection with the symposium on spraying machinery, members are requested to bring to the meeting, for exhibit or demonstration, any spraying devices which have given superior results and to come prepared to join in a full discussion of both of these important subjects.

PROGRAM

Report of the secretary.

Report of the committee on nomenclature, Mr. Herbert Osborn, chairman, Columbus, Ohio.

Report of the committee on testing proprietary insecticides, by E. D. Sanderson, chairman, Morgantown, W. Va.

Report of the committee on affiliation, by Mr. Lawrence Bruner, chairman, Lincoln, Neb.

Report of the executive committee, by President E. D. Sanderson, Morgantown, W. Va.

Appointment of committees.

Miscellaneous business.

New business.

Annual address of the president, by E. D. Sanderson, Morgantown, W. Va., " The Work of the American Association of Economic Entomologists."

Reading of Papers

"Economic Entomological Investigations Now Under Way," by T. J. Headlee, Manhattan, Kansas.

"Farm Methods for Controlling Southern Field Crop Insects," by A. F. Conradi, Clemson College, S. C. (20 minutes.)

A discussion of fall and winter cover crops, clean cultivation on low lands, effects of terracing and methods of spring forcing of field crops.

"Economic Importance of *Stictocephala* sp.," by Herbert Osborn, Columbus, Ohio. (7 minutes.)

Records of occurrence of *Stictocephala* on cultivated crops and some notes on mode and extent of injury.

"Studies on the Cabbage Maggot," by W. J. Schoene, Geneva, N. Y. (15 minutes.)

Habits and life history in New York State.

"Habits of the Cabbage Aphis with Suggestions for its Control," by Glenn W. Herrick, Ithaca, N. Y. (10 minutes.)

"Fatal High Temperature for the Control of Mill Insects," by George A. Dean, Manhattan, Kan. (10 minutes.)

The results of several experiments in heating a flour mill to temperatures that proved fatal to the insects infesting it.

Adjournment.

Program

Tuesday, December 28, 1 *p. m.*

Joint session with the Entomological Society of America.

Reading of Papers

"Some Notes on the Pear Slug, *Eriocampoides limacina* Retz," by R. L. Webster, Ames, Iowa. (10 minutes.)

"Summary of the Food Habits of American Gall Midges," by E. P. Felt, Albany, N. Y. (10 minutes.)

"Locomotion of Certain Young Scale Insects," by H. J. Quayle, Whittier, Cal. (8 minutes.)

An account of experiments on the rate and distance of travel of the active young of the Black, Purple and Red scales over smooth surfaces, sand and orchard soil.

"Locomotion of the Larva of *Calosoma sycophanta,*" by A. F. Burgess, Melrose Highlands, Mass. (7 minutes.)

Record of the distance travelled by a larva of this species from the time of hatching until its death, no food having been furnished, and the method of securing the data.

"The Effect of Certain Gases and Insecticides upon the Activity and Respiration of Insects," by George D. Shafer, East Lansing, Mich. (35 minutes.) (Charts of apparatus and data tables.)

A presentation of the results obtained in a study of the effect of some common gases and insecticides upon the activity and respiration of insects as compared with their normal activity and respiration. The study has been made to obtain evidence that will help in deciding the question, "How do insecticides kill?"

"Instructional Methods in Economic Parasitology with Reference to California," by W. B. Hermes, Berkeley, Cal. (10 minutes.)

Needs of the student and the state in a field of vast importance to public health and animal industry.

Symposium

On "The Present Methods of Teaching Entomology."
Papers by J. H. Comstock, Ithaca, N. Y.
H. T. Fernald, Amherst, Mass.
Herbert Osborn, Columbus, Ohio.
Lawrence Bruner, Lincoln, Neb.

The discussion will be opened by the following members, and a general discussion will follow:

John B. Smith, New Brunswick, N. J.
S. A. Forbes, Urbana, Ill.
V. L. Kellogg, Stanford University, Cal.

Adjournment.

Program

Thursday, December 29, 10 a. m.

Discussion of the presidential address.

Reading of Papers

"Methods of Securing the Fertilization of Clover by Means of Bumble Bees in Experiments with *Bruchophagus funebris,*" by F. L. Washburn, St. Anthony Park, Minn. (10 minutes.)

"Apparatus for the Study of Subterranean Forms," by S. J. Hunter, Lawrence, Kan. (10 minutes.) Lantern slides.

"A New Sawfly Enemy of the Bull Pine in Nebraska," by Myron H. Swenk, Lincoln, Neb. (15 minutes.) Lantern slides.

A brief account of the ravages and natural enemies and, in part, the life-history of a new Lophyrine enemy of *Pinus ponderosa scopulorum.*

"Notes on the Larch Sawfly in Minnesota," by A. G. Ruggles, St. Anthony Park, Minn. (10 minutes.)

An account of the range of the species and the damage done in Minnesota, with notes on the enemies, both insect and fungus.

"Azolla and Mosquitoes," by John B. Smith, New Brunswick, N. J. (10 minutes.)

Account of investigations made in Germany and Holland on the ecology of Azolla species, and the effect on mosquito breeding.

"Anti-Mosquito-Malaria Campaigns in California—Methods and Results," by W. B. Hermes, Berkeley, Cal. (15 minutes.)

A brief review of the anti-mosquito campaigns carried on under the direction of the writer during the year 1910.

"Oviposition among Tree Crickets," by P. J. Parrott, Geneva, N. Y. (10 minutes.)

Studies of three common species as to egg-laying habits.

"Some Notes on Injurious Leaf Hoppers," by Herbert Osborn, Columbus, Ohio. (10 minutes.)

A discussion of some of the species destructive to cultivated crops.

"Notes on the Wheat-Head Army-Worm, *Meliana albilinea* Hbn., as a Timothy Pest," by R. L. Webster, Ames, Iowa.

Notes on the life-history, habits, food plants, natural enemies and control of the insect.

Adjournment.

Program

Thursday, December 29, 1 p. m.

Symposium

On "Spraying Machinery—Its Present Desirable and Undesirable Features."

Papers by E. D. Ball, Logan, Utah.
A. L. Quaintance, Washington, D. C.
L. H. Worthley, Boston, Mass.
E. L. Worsham, Atlanta, Ga.

The discussion will be led by the following members:
T. B. Symons, College Park, Md.
T. J. Headlee, Manhattan, Kansas.
E. P. Felt, Albany, N. Y.
E. P. Taylor, Grand Junction, Colo.
W. E. Britton, New Haven, Conn.

A general discussion will follow and an opportunity will be offered for the exhibition and explanation of new or improved spraying devices that may be submitted by the members of the Association.

Reading of Papers

"Some Ways of Getting Entomological Information Before the Public," by H. A. Gossard, Wooster, Ohio. (To be read by title.)

"Some Properties that Make Lime and Sulfur Wash Effective in Killing Scale Insects," by George D. Shafer, East Lansing, Mich. (15 minutes.)

The results of experiments that seem to point out the properties of the lime and sulfur wash that make it effective in killing scale insects.

"Life History of the Rice Weevil (*Calandra oryza* L.) in Alabama," by W. E. Hinds, Auburn, Ala.

"Spraying with Linseed Oil Wash for the Oyster Shell Scale," by R. L. Webster, Ames, Iowa. (2 minutes.)

A brief account of a successful treatment of the oyster shell scale with a linseed oil emulsion.

"Results of Test Sprayings for Gloomy and Euonymus Scales," by Z. P. Metcalf, Raleigh, N. C. (10 minutes.)

A brief summary of the results of two years' tests against these insects.

"The Terrapin Scale in Maryland," by T. B. Symons and E. N. Cory, College Park, Md. (10 minutes.)

Discussion of this scale in Maryland, injury it is doing and results of experiments for its control.

"The Woolly Aphis, *Schizoneura lanigera*," by S. J. Hunter, Manhattan, Kansas. (10 minutes.)

Additions to its life history and behavior; experiments in control.

"New Data on the Apple Maggot," by W. C. O'Kane, Durham, N. H. (5 minutes.)

Brief summary of some of the results secured in the past summer's work at the New Hampshire Station.

"Some Results from Spraying for the Codling Moth," by R. W. Braucher, Douglas, Mich. (20 minutes.)

An analysis of some of the results obtained in spraying for the codling moth and some conclusions and problems to be drawn from them.

"Notes on the Egg Laying Habit of *Sanninodea exitiosa* Say," by E. N. Cory, College Park, Md. (7 minutes.)

"A Co-operative Experimental Field System," by A. F. Conradi, Clemson College, S. C. (10 minutes.)

A discussion showing the necessity of such a system under South Carolina conditions and the method by which it is carried out.

"Notes on Some Insects Injurious in Nebraska During 1910," by Myron H. Swenk, Lincoln, Neb. (10 minutes.)

Remarks on several cases of insect damage of a severe or unusual character.

"Entomological Review of the Year in Ohio," by H. A. Gossard, Wooster, Ohio. (To be read by title.)

Reports of committees.
Miscellaneous business.
Election of officers.
Fixing time and place of the next meeting.
Adjournment.

A. F. Burgess, *Secretary*,
Melrose Highlands, Mass.

E. D. Sanderson, *President*,
Morgantown, W. Va.

NINTH ANNUAL MEETING
ASSOCIATION OF HORTICULTURAL INSPECTORS

Minneapolis, December 29 and 30, 1910

First Session — Thursday 8 p. m.

Parlors, Dyckman Hotel

Program

Organization.
President's annual address, F. L. Washburn, St. Anthony Park, Minn.
Report of committee on affiliation, T. B. Symons, College Park, Md.
Report of committee on permanent organization, G. G. Atwood, Chairman, Albany, N. Y.
Miscellaneous business.

Second Session — Friday 10 a. m.

Room 23, School of Mines Building, State University

Call to order.
Discussion of president's address.
"New York Nursery Inspection," G. G. Atwood, Albany, N. Y.
"European Conditions in 1910 and General Inspection Prospects," L. O. Howard, Washington, D. C.
"A Practical Method of Inspecting Imported Seedlings," etc., T. B. Symons, College Park, Md.

Third Session — Friday 1 p. m.

Call to order.
"The Practicability of Nursery Quarantine Stations in Different States," A. H. Conradi, Clemson College, S. C.
"The Health of Plants as Related to Insects," J. B. S. Norton, College Park, Md.
"Report of Committee on Treatment of Infested Nursery Stock in Different States," Franklin Sherman, Jr., Raleigh, N. C.
"Results of Experiments in Dipping Trees and Fumigating Peach Buds," T. B. Symons and E. N. Cory, College Park, Md.
Report of committee on national legislation.
Election of officers.
Miscellaneous business.
Adjournment.

Questions for Discussion

1. The Kind and Form of Information Concerning Individual Nurseries to be Furnished by an Inspector to Inspectors of other States.
2. What is the Opinion of State Inspectors Regarding the Sale of Strawberry Plants from Districts Known to be Infested with the Strawberry Root Louse?
3. What is the Best way to Treat Nursery Stock Infested with the San José Scale where such Stock is to be planted in Infested Orchards or sections, the owners of which do not regard San José Scale Infestation Serious, they having adopted adequate spraying methods for its control.
4. Assuming that Nurserymen may demand that their trees shall be treated for San José Scale instead of being destroyed what formula for treatment should be employed?
5. Why does Fumigation with Hydrocyanic-acid-gas occasionally fail?
6. Will dipping nursery trees in lime-sulfur solution prove effective? If so, should roots be immersed?
7. What action should be taken by Horticultural Inspectors in reference to Imported Bulbs, Herbaceous and Green House Plants.
8. What progress has been made in barring Wormy and Scale Infested Fruits from the Markets in Different States?
9. What is the present state of Crown Gall on Apple?
   - A. Relation of Crown Gall and Hairy Root.
   - B. Prevention of this disease in the Nursery.
   - C. Inspection and Requirements for Crown Gall.
   - D. Contagiousness.